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SUBJECT: Forwards final response to IE Bulletin 79-02,Revision 2 & SER outstanding Issue 5 re component supports 3.9.3.3.No further action necessary for closure of issue.

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Washington Public Power Supply System
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

April 22, 1982
G02-82-394
SS-L-02-PLP-82-22

Docket No. 50-397

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
SAFETY EVALUATION REPORT OUTSTANDING
ISSUE (5) COMPONENT SUPPORTS (3.9.3.3)

Reference: Letter, R.G. Matlock (SS) to R.H. Engelken (NRC), "IE Bulletin No. 79-02, Rev. 2" (Attached)

The attached letter submitted the final WNP-2 response to IE Bulletin 79-02, Rev. 2. This bulletin is also Outstanding Issue (5), Component Supports (3.9.3.3), of the WNP-2 SER, NUREG-0892. By submittal of the attached report the Supply System considers the issue adequately addressed and no further action is necessary for closure of this issue.

Should you have any further comments, please contact Mr. R.M. Nelson, WNP-2 Project Licensing Manager.

Very truly yours,

G. D. Bouchey
Deputy Director, Safety and Security

PLP/jca
Attachment

cc: R Auluck - NRC
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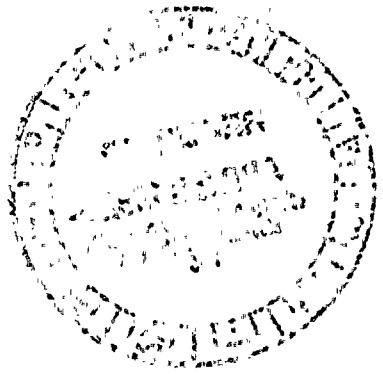

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FINAL RESPONSE TO

NRC IE BULLETIN 79-02, REV. 2

FOR

WASHINGTON NUCLEAR PLANT (WNP-2)

HANFORD WASHINGTON

BY

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

RICHLAND, WASHINGTON

March 31, 1982

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INTRODUCTION

The Nuclear Regulatory Commission IE Bulletin No. 79-02, dated March 8, 1979, directed holders of Nuclear Power Plant Construction permits to respond to the concerns of the NRC regarding the reliability of pipe support base plates that use concrete expansion anchor bolts in Seismic Category I Piping Systems as defined by Regulatory Guide 1.29, "Seismic Design Classification", Revision 1, dated August 1973, or as defined in the applicable FSAR. Revision 1 of the Bulletin, providing clarifications, was issued June 21, 1979. Revision 2 of the Bulletin, providing additional clarification and new items of concern, was issued November 8, 1979. This final response supercedes the previously submitted response and addresses the Bulletin "Action Items" as given in Revision 2 of the Bulletin. Action Item No. 7 is not applicable to WNP-2 and Action Item No. 8 does not require a response. In this reply, the NRC "Action Item" is first stated followed by the Washington Public Power Supply System response.

NRC ACTION ITEM NO. 1

Verify that pipe support base plate flexibility was accounted for in the calculation of anchor bolt loads. In lieu of supporting analysis justifying the assumption of rigidity, the base plates should be considered flexible if the unstiffened distance between the member welded to the plate and the edge of the base plate is greater than twice the thickness of the plate. It is recognized that this criterion is conservative. Less conservative acceptance criterion must be justified and the justification submitted as part of the response to the Bulletin. If the base plate is determined to be flexible, then recalculate the bolt loads using an appropriate analysis. If possible, this is to be done prior to testing of anchor bolts. These calculated bolt loads are referred to hereafter as the bolt design loads. A description of the analytical model used to verify that pipe support base plate flexibility is accounted for in the calculation of anchor bolt loads is to be submitted with your response to the Bulletin.

It has been noted that the schedule for analytical work on base plate flexibility for some facilities extends beyond the Bulletin reporting time frame of July 6, 1979. For those facilities for which an anchor bolt testing program is required (i.e., sufficient QC documentation does not exist), the anchor bolt testing program should not be delayed.

1.0 RESPONSE TO ACTION ITEM NO. 1

1.1 INTRODUCTION

The WNP-2 Contractors affected by the Bulletin requirements are Primary Containment (C213A), Mechanical Equipment Installation and Piping (C215), HVAC and Plumbing Installation (C216), Fire Protection Systems (C217), Instrument Installation (C220), and Spray Pond Piping (C233).

Pipe Supports and their base plates have mainly been designed by these contractors and their subcontractors. The supports installed by C213A and C233 were designed by the Engineer.

The total number of Seismic Category I supports is approximately 16,000; one third support large diameter piping (above 2 inches) and the remainder support small diameter piping (2 inches and smaller).

These Seismic Category I pipe supports are supported from structural steel, embedded plates, cast-in-place inserts or by expansion bolts. Only the expansion bolt installations are the subject of this response. Approximately 3,000 supports use expansion bolts of which nearly 2,000 were installed by Contract 215 and by C213A.

1.2 ORIGINAL BASE PLATE DESIGN

From an examination of the contractor's pipe support calculations, it is clear that they used a rigid plate design throughout. Preload was neglected in the design approach although the installation specifications required expansion bolts to be preloaded in excess of the bolt design load. Additionally, no concrete compression was assumed, and bending and torsion were resisted by the respective moments of inertia of the bolt group.

1.2.1 WNP-2 Original Design Method

In the Original Design Method at WNP-2, the highest loaded (critical) bolt is assumed to fail causing the remaining bolts to carry the loading.

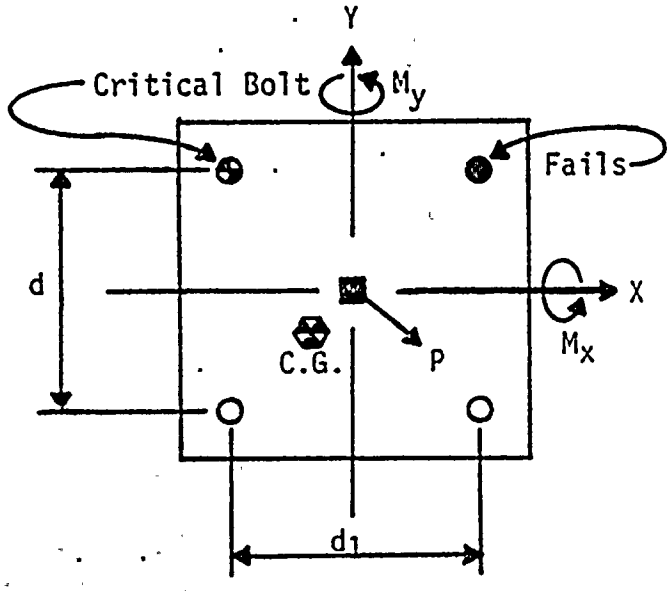
First, the plate is analyzed as rigid and the loads are resisted by the moment of inertia of the bolt pattern. The bolts are assumed to carry all the shear, tension, and compression. No loading occurs between the plate and the concrete.

Next, the critical bolt is removed from the bolt pattern and the new center of gravity (CG) of the bolt pattern is located. The applied loads are transferred from the attachment to the new CG.

Finally, the plate is analyzed with the critical bolt missing for the new configuration and the remaining bolts are checked for adequacy.

EXAMPLE:

FOUR BOLT PLATE ($M_x > M_y$)



$$\text{BOLT LOAD} = \frac{5P}{12} + \frac{M_x}{d} + \frac{M_y}{2d_1}$$

Shear is assumed to be distributed equally among the bolts. This assumption receives support in the discussion for steel bolted connections of Reference 5. This text deals in its entirety with bolted and riveted joints. For these steel bolted connections, shear is distributed relatively equally when the number of bolts on line is limited. For example, from Reference 5, consider four fasteners in line. The plate material is A36 and the fasteners are 7/8" A325 bolts. The shear stress is approximately 42 ksi for the two inside bolts and approximately 46 ksi for the two outside. The difference for four in line is slight. We conclude that the difference for three or less fasteners on line will be negligible. Our most frequent case is to have three or less on line.

The bolt loads (tension and shear) determined from this method were then combined in a linear interaction formula to account for combined effects of shear and tension on the bolts. The interaction formula was formulated as follows:

$$\frac{f_t \text{ (actual tension)}}{F_t \text{ (allowable tension)}} + \frac{f_s \text{ (actual shear)}}{F_s \text{ (allowable shear)}} \leq 1 \qquad (1)$$

1.2.2 Increases in Stress Allowable

The International Conference of Building Officials (ICBO) report (Reference 2) permits anchor allowable loads to be increased one-third for short time loading such as wind or seismic forces. The Engineer and WNP-2 Contractors used the same design criterion. Additional justification for this action is provided by the ASME Code for Subsection NF components such as base plates. This Code allows an increase of nearly 100 percent in the allowable loads for NF component under faulted (seismic) loading conditions.

1.2.3 Preload of Bolts

The advantages of anchor bolt preload were neglected for design purposes. However, they were preloaded during installation to over 100 percent of their allowable tension load. Preload is fully discussed in the response to Action Item No. 4.

1.3 FINAL BASE PLATE DESIGN AND QUALIFICATION

In response to the Bulletin, all flexible Seismic Category I pipe support base plates are being qualified by flexible plate analysis. Factors of safety higher than those originally used are now being utilized. For maximum support load (typically faulted condition) a 33 percent increase in allowable anchor load is no longer permitted. The following is a discussion of the current analytical method used for both design and final qualifiation at WNP-2.

1.3.1 Flexible Base Plate Analysis

Base plates are considered flexible when the unstiffened distances between member welded to the plate and the edge of the base plate is greater than twice the thickness of the plate. Most base plates without stiffeners are categorized as flexible. Analysis of flexible base plates is being performed with a finite element computer program, ANSYS (Reference 4). If a computer evaluation is not performed, a comparision is made to a typical base plate with greater flexibility. Since these typical base plates were evaluated by ANSYS for flexibility, all subject base plates have flexibility included in the evaluation of anchor loading.

1.3.2 Description of Analytical Model

In the manner of assessment presented in Reference 8, flexible base plates are evaluated with a finite element computer program, ANSYS (Reference 4).

Consideration is given to plate and concrete stiffness, expansion bolt stiffness and proper dimensions of the attachment. The unique computer program capabilities are used to perform a static, elastic, non-linear finite element solution. Additionally, a preprocessor program is used to simplify the input.

The steel plate is represented by quadrilateral and/or triangular plate shell elements. This element, STIF 63, has six degrees of freedom at each node and permits both bending and membrane loading. Located below each plate node is an element which simulates the concrete.

The concrete is represented by a STIF 40 element type which has a spring constant and a gap. A STIF 40 combination element is used to resist the compressive forces in the vertical direction between the plate element and the concrete. Since this element has gap capability, only compressive forces will occur. A non-linear iterative solution is therefore required to assure a converged and accurate solution.

The concrete spring constants, K, are calculated using elastic half space theory as follows:

$$K = \frac{4G\ Ro}{1-v} = \frac{4G\sqrt{A}}{\sqrt{\pi}(1-v)} = 4506\sqrt{A}$$

Where:

G = the shear modulus of concrete

Ro = the effective radius of the concrete area in contact with the plate

v = is the Poisson's Ratio of concrete

A = is the effective contact area = πRo^2

Attachments welded to the base plate transmit the pipe support load to the base plate. These attachments provide a stiffening effect (reduces out-of-plane bending) which is modeled as a rigid region on the common plate nodes. Since the applied loads occur at the attachment center of gravity, the plate model provides a collocated node for applying loads.

The anchor bolt element is also simulated as a spring gap element, STIF 40. However, this element is modeled to support tension only. As a two node element, one node is common to the plate mesh at bolt locations and the other node is fixed to ground.

The anchor bolt stiffness used is an important factor in determining the base plate load distribution and the final anchor bolt loading. The primary factors which determine this anchor loading are the plate flexibility and anchor bolt stiffnesses. The anchor bolt stiffness is provided to the finite element computer program as a spring rate. Pull tests performed on Site were used to determine realistic spring rates. At Hanford WNP-2, the shell type anchors (HDI's) are the most common expansion anchor type. Since test results show this anchor type normally exhibits a constant stiffness (elastic characteristic) to ultimate load capacity, a bilinear spring rate simulation is not required.

For Hilti Super Kwik (HSK) type anchors, a ductile behavior is exhibited and the bolt stiffness is conservatively taken as the initial slope of the load deflection curves from Reference 3.

Table II provides the elastic spring rates conservatively used for each type of anchor.

1.3.3 Shear and Tension Interaction

The basic tension interaction in conjunction with basic allowable shear interaction is combined with the following elliptical equation:

$$I_{Total}^{4/3} = I_{Tension}^{4/3} + I_{Shear}^{4/3} \qquad (2)$$

Where:

I_{Total} = Total interaction ≤ 1.0

$I_{Tension}$ = $\frac{\text{Calculated tensile bolt load}}{\text{Allowable tension bolt load}}$ Or see section 1.3.4 for typical base plates

I_{Shear} = $\frac{\text{Calculated shear bolt load}}{\text{Allowable shear bolt load}}$

It is to be noted that in this interaction formula, the flexibility of the plate affects only the tension portion of the formula not the shear portion.

1.3.4 Typical Base Plates

Typical base plate configurations were analyzed on the finite element computer program. The maximum support loads found by solving individual load cases on four, six, eight, and ten bolt base plates with and without stiffeners. The results were used to formulate an empirical equation to permit load combinations. An example of a four bolt base plate is shown below:

$$I_{Tension} = \frac{\text{Pullout}}{\text{Allowable Pullout}} + \frac{Mx + My}{\text{Allowable Moment}}$$

Where:

$I_{Tension}$ = Tension interaction

Pullout = Applied tensile pullout

Mx and My = Applied moments in the x and y directions

Pullout Allowable = Allowable base plate pullout based on finite element evaluation

Moment Allowable = Allowable base plate moment based on finite element evaluation

For base plates with larger attachments or thicker plates, less plate flexibility will occur and the interaction equation can be conservatively utilized.

1.4 COMPARISON OF RIGID AND FLEXIBLE ANALYSIS

1.4.1 Conventional Rigid Plate Theory

The simplest method and perhaps the most common method for performing base plate evaluations is to assume the plate rotates rigidly about one edge. Using all the bolts as active members, the maximum bolt load can be solved by static equilibrium. Although this method for performing base plate evaluations was not used for design purposes on WNP-2, the method is used only for comparative purposes with the original design concept and the final qualification method. This method is commonly used in industry.

1.4.2 Examples

Flexible Plate Analysis : Bulletin requirement (Current Evaluation)

WNP-2 Original Design Method : One bolt redundant was originally used.

Conventional Rigid Plate Analysis : Common design by industry before Bulletin 79-02

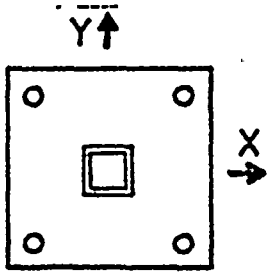
To provide a fair means of comparison of analytical methods in the following examples, the tension expansion anchor allowable is constant at 4.53 KIPS for 3/4" HDI and shear loading is neglected.

Typical Four Bolt Base plate

Dimensions: 12X12X3/4

Bolt Spacing: 9" center to center

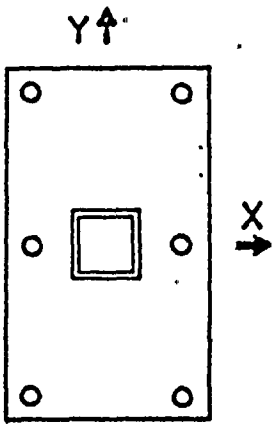
Attachment: TS 3X3



Type of Analysis	Allowable Plate Pullout (KIPS)	Allowable Plate Moment (IN.KIPS)
Flexible Plate Analysis	14.0	66.9
WNP-2 Original Design Method	10.5	40.8
Conventional Rigid Plate Analysis	18.1	97.1

Conclusion

WNP-2 Original Design Method is conservative for this four bolt plate and most four bolt plates previously installed.



Typical Six Bolt Base plate

Dimensions: 21X12X1

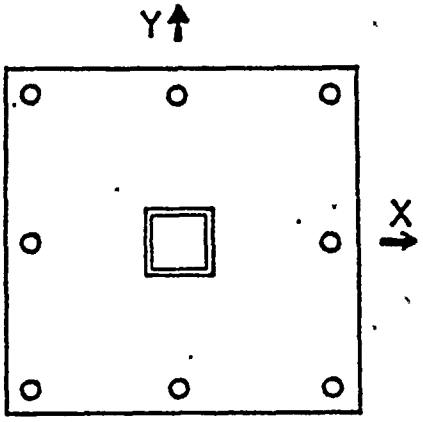
Bolt Spacing: 9" center to center

Attachment: TS 5X5

Type of Analysis	Allowable Plate Pullout (KIPS)	Allowable Plate Moment-X (IN.KIPS)
Flexible Plate Analysis	12.3	133.
WNP-2 Original Design Method	17.9	95.1
Conventional Rigid Plate Analysis	27.2	299.

Conclusion

WNP-2 Original Design Method has mixed results.



Typical Eight Bolt Base plate

Dimensions: 21X21X1

Bolt Spacing: 9" center to center

Attachment: TS 5X5 or W6X25

Type of Analysis	Allowable Plate Pullout (KIPS)	Allowable Plate Moment (IN.KIPS)
Flexible Plate Analysis	20.1	112.6
WNP-2 Original Design Method One Bolt Redundant	25.0	173.6
Conventional Rigid Plate Analysis	36.2	318.

Conclusion

WNP-2 Original Design Method produced non-conservative loading capability compared to flexible plate analysis.

1.4.3 Comparison

The purpose of this section is to show conclusively that the design criteria used during final qualification of WNP-2 base plates satisfies the bulletin's analytical concerns.

Figure 1.4 shows the bolt tensile load on a typical support with an eight bolt base plate. These curves provide an overview of analytical methods.

1) Curve A represents conventional rigid plate theory, which was the most common methods used by others prior to issuance of the Bulletin.

2) Curve B represents the WNP-2 Original Design Method used.

3) Curve C represents flexible plate theory without preload.

   This curve is used to determine the allowable support load for a flexible plate since the only applied loading is pipe support loading.

4) Curve D represents a preloaded anchor bolt with flexible plate theory. Verified by test results (Section 5), this curve simulates the actual bolt load.

5) Curve E represents the theoretical behavior of a preloaded rigid plate.

1.4.4 Summary

The comparison study shows that for small plate up to 12X12, with four bolts and a minimum thickness of 3/4", the WNP-2 Original Design Method provided satisfactory results. However, as the plate gets larger and more bolts are included, the flexible plate approach provides a more accurate method for determining bolt loads. In addition, as shown in Curve D, the actual bolt load increased only 1.0 KIP over preload when the design support load is applied. Thus, the cyclic stresses due to alternating support loading is minimized and the Bulletin concern for alternating stresses due to dynamic loading is satisfied.

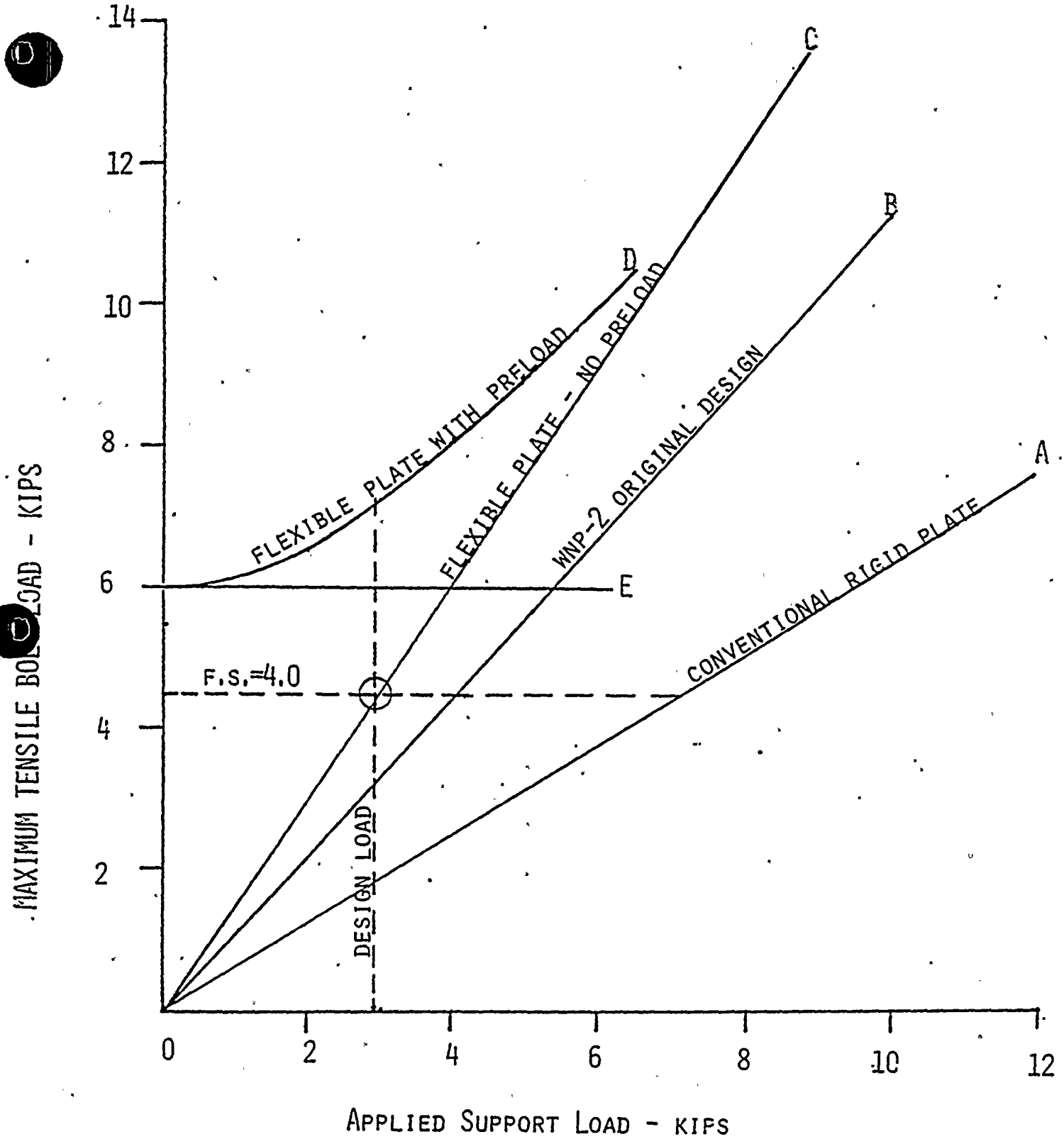


FIGURE 1.4 COMPARISON OF ANALYTICAL METHODS ON EIGHT BOLT BASE PLATE

1.5 TESTING

1.5.1 Description

A series of tests have been performed at the WNP-2 Site under actual field conditions to verify the analytical results for six bolt and eight bolt patterns. A typical hanger (see Figure I) was loaded in a manner simulating actual field conditions. The hanger was instrumented to measure strain and deflections. Load sensing bolts were used to measure strain in Bolts B1, B2, B3, and B4.

The 3/4 inch Dia Hilti Drop-In expansion bolts were torqued to preload of greater than the allowable design load. Then, tension load increments were applied by means of a hydraulic ram at a 36 inch eccentricity from the centerline of the plate. The applied loads were 1.33^{k}, 2.76^{k}, 3.0^{k}, 5.33^{k}, and 10.67^{k}.

1.5.2 Comparison of Test and Analytical Results

A comparison of the results of the loads in the expansion bolts from the analytical analysis and the test for a range below and above design load is presented in Table 1.5.

The analytical results typically agree with the test results to within 10% even when the applied support load is two times the support design load. A plot comparing the analytical results with the test results for this test and three additional tests is summarized below.

Test No.	Figure No.	Approximate Maximum Loading	Type of Plate
1	II	.4x Design	Eight Bolt
2	III	9x Design	Eight Bolt
3	IV	3x Design	Eight Bolt
4	V	2x Design	Six Bolt

During Test 2, the support load was increased to ultimate. The ultimate load was defined to be the point where the hanger would no longer resist the applied load due to excessive deflection in the support wide flanges. This ultimate load (26.0 KIPS) was approximately nine times the design load established for final qualification of WNP-2 base plates. since the critical anchor (Bolt No. 3) apparently initiated slip at a support load of 17.5 KIP, a load redistribution occured and considerable difference between test and ANSYS predicted results occured. (ANSYS predicted much higher loads.)

Test 3 and Test 4 results show similar correlation.

Table 1.5

Bolt Load Comparison

Applied Load (KIPS)	Bolt No.	Test	Analytical	% Difference
Preload Only	B1	5.54	5.54*	0
	B2	5.09	5.04*	0
	B3	5.55	5.55*	0
	B4	6.29	6.29*	0
1.33	B1	5.54	5.59	1.0
	B2	5.29	5.07	4.3
	B3	6.34	5.75	10.3
	B4	6.35	6.31	0.6
2.67	B1	5.60	5.72	2.1
	B2	5.54	5.18	6.9
	B3	7.01	6.61	6.0
	B4	6.44	6.91	0.5
3.0	B1	5.66	5.94	4.9
	B2	5.80	5.80	9.4
	B3	7.76	7.71	0.6
	B4	6.49	6.52	0.5
5.33	B1	5.86	6.48	10.6
	B2	6.21	5.78	8.4
	B3	8.92	9.03	1.2
	B4	6.60	6.81	3.2
10.67	B1	7.28	8.75	20.2
	B2	8.08	7.71	4.8
	B3	14.90	16.25	8.5
	B4	6.99	8.70	24.

*Analytical preloads were made equal to test preload values by using unequal preload displacements on the ground nodes.

1.6 DISCUSSION OF CYCLIC LOADING

The main reason that WNP-2 expansion bolts are preloaded to a value above the bolt allowable load is to reduce stress reversals in the bolts subjected to cyclic loads. This preload procedure also ensures that each bolt is properly installed and achieves a minimum load carrying capacity equaling the preload value. The preload is greater than the bolt allowable load.

A similar approach is used in standard high strength steel bolted connections. For high strength A325 and A490 bolts, (Reference 6), a preload to 70 percent of the ultimate tensile strength of the bolt is recommended, but the allowable load of the bolt is only 60 percent of the yield point. The resulting ratio between the preload and allowable load is approximately two.

Generally, under applied design load the actual expansion bolt load becomes sightly greater than preload. Since each expansion bolt is installed with a prescribed preload, it is assured that it can carry this load after installation.

In the analysis of the typical eight bolt pattern, it was found that utilizing the flexible plate approach in the determination of bolt load, the bolt load increased only one KIP over that obtained by (preloaded) rigid plate analysis. However, this increase occurs on one bolt of the group only, while the stress in the remaining bolts equal or slightly exceed the preload stress. Thus, while it is apparent that this one bolt is subject to a stress increase when flexible plate approach is considered, the remaining bolts in the bolt group are not.

Our results are similar to those presented in Reference 5 for tension T-connections. In the T type, the bolt load increase above the preload bolt force due to applied loads is kept small. Thus, our results confirm results from standard steel practice.

1.7 MAJOR CONSERVATISMS

We have presented results thus far for the effect of flexibility upon bolt design and how the consideration of flexibility provides a more accurate means of bolt determination in achieving a suitable factor of safety. However, there are additional major factors which contribute to insuring safety. These include conservatisms in accounting for shear and tension interaction, conservative seismic loads used in design, and high quality expansion bolt testing program. These conservations are discussed in more detail in the following sections.

1.7.1 Interaction of Shear and Tension

The shear and tension interaction of an expansion bolt is conservative in three respects. First, the interaction formula (Equation 1) combines the effects of shear and tension conservatively. Figure VI compares Equation 2 with the actual interaction (Reference 10) of shear and tension. Second, shear is distributed equally to all bolts whereas for a flexible plate, each of the tension loads is not uniform. And while the use of the interaction formula will produce a result for the bolt with the highest tensile strength it should be pointed out that the strength of a pipe support is dictated by the capability of all of the bolts in the support and over emphasis should not be placed on the capability of one bolt where if any overstress occurs, there will be a redistribution of load to the remaining bolts which are not as highly stressed. Third, the clamping caused by the preload gives frictional resistance which increases the capacity of the plate to carry applied shear.

1.7.2 Seismic Load

The seismic loads used in the hanger design are based on the following conservative seismic analysis of all Seismic Category I structures.

A lumped mass model representing a Seismic Category I building was used in computing the floor response spectra. In this model, the soil-structure interaction effects were accounted for by lumped springs and lumped viscous dampers. The damping coefficients of these dampers, conservatively calculated from the solution of a rigid footing on an elastic half space, are given in the following table. Also shown in the table are the actual damping values used in the seismic analysis.

SOIL DAMPING RATIO

Seismic Category I Building	Elastic Half Space Theory			Actual Values Used in Analysis		
	Horiz.	Rocking	Vert.	Horiz.	Rocking	Vert.
Reactor Building	32	8	66	10	5	10
Radwaste Building	39	65	98	10	5	10
Diesel Generator Building	38	22	63	10	5	10

The Building responses from lumped mass modeling are very conservative because soil material and geometric dampings are purposely kept low.

A more realistic finite element modeling of the soil structural interaction effect has been subsequently used to recalculate the building responses of the Seismic Category I buildings. The computer program, FLUSH, Reference 9, is used for this purpose. The geometric damping effect due to infinite boundaries and nonlinear soil properties for both shear moduli and material damping are properly accounted for in the analysis.

The structural responses from the finite element analysis are substantially lower than those which have been used as input to the hanger design. Figures VII and VIII demonstrate the reductions in typical floor response spectra as discussed above.

Although this conservation is applicable to the majority of the concerned pipe supports at the WNP-2 Project, there is one exception to this, namely the pipe supports in the wetwell. For these pipe supports, this conservatism is not available.

1.7.3 Expansion Bolt Testing

Field testing of expansion bolts has been conducted at WNP-2 over a period of two years to provide a custom made criteria applicable to the actual project site. The testing program as discussed in our response to Action Item No. 2 has provided data as to capacities of the WNP-2 expansion bolts, and other characteristics, such as load deflection behavior and failure mechanisms.

1.7.4 Anchor Bolt Stiffness

The essentially bilinear nature of the ductile behavior exhibited by the expansion anchor bolts used at WNP-2 has not been used in the analytical model of the flexible base plate. Typically, expansion anchor bolts exhibit some ability to slip but yet maintain their capability to carry load. This unique ability provides a load-limit feature for the critical anchor and permits a load redistribution for the base plate. Evidence of this redistribution was seen during the pipe support test performed on site (see Section 1.5). When the support load reached approximately six times design load, apparent anchor slippage occurred permitting the support to reach approximately nine times design load without anchor failure. Figure 1.7 shows this comparison. Therefore, the factor of safety for a pipe support can more accurately be represented by the capacity of all the bolts rather than that one critical bolt. As a result, the flexible plate analysis performed at WNP-2 induces considerable conservatism relative to the Bulletin strength requirements.

1.8 CONCLUSIONS

In response to the Bulletin's concerns, all flexible Seismic Category I pipe support base plates are being designed and qualified by flexible plate analysis. At WNP-2, the effects of flexibility on small (four bolt) plates is minimal compared to the Original Method of Analysis. Where it is found to be significant on larger plates with a greater number of bolts, additional stiffening of plates is being added to ensure that excessive bolt load does not occur.

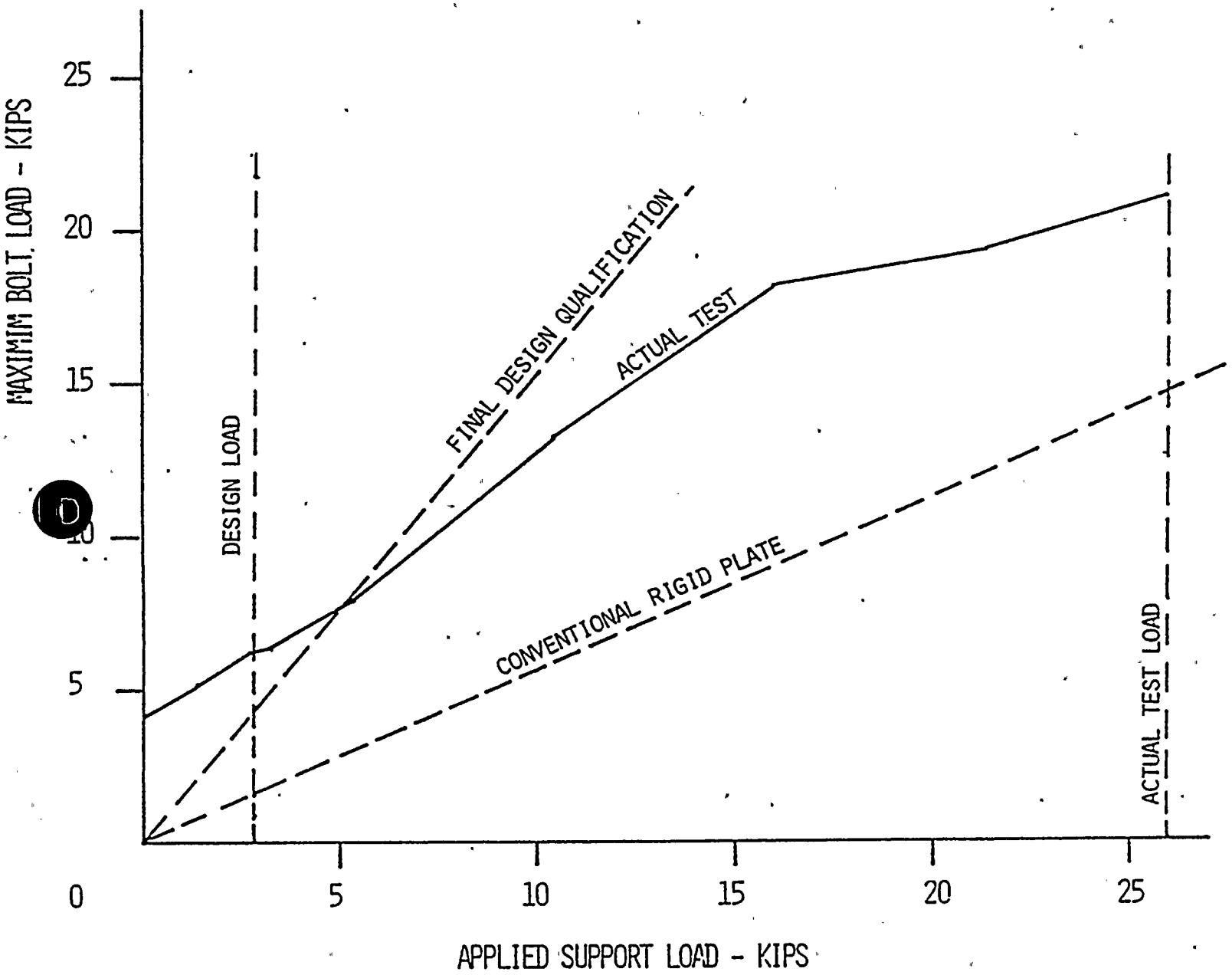


FIGURE 1.7 COMPARISON OF TEST RESULTS TO ANALYTICAL METHOD

NRC ACTION ITEM NO. 2

Verify that the concrete expansion anchor bolts have the following minimum factor of safety between the bolt design load and the bolt ultimate capacity determined from static load tests (e.g., anchor bolt manufacturer's) which simulate the actual conditions of installation (i.e., type of concrete and its strength properties):

a. Four - For wedge and sleeve type anchor bolts,

b. Five - For shell type anchor bolts.

The bolt ultimate capacity should account for the effects of shear tension interaction, minimum edge distance and proper bolt spacing.

If the minimum factor of safety of four for wedge type anchor bolts and five for shell type anchors cannot be shown then justification must be provided. The Bulletin factors of safety were intended for the maximum support load including the SSE. The NRC has not yet been provided adequate justification that lower factors of safety are acceptable on a long term basis. Lower factors of safety are allowed on an interim basis by the provisions of Supplement No. 1 to IE Bulletin No. 79-02. The use of reduced factors of safety in the factored load approach of ACI 349-76 has not yet been accepted by the NRC.

2.0 RESPONSE TO ACTION ITEM NO. 2

2.1 INTRODUCTION

At WNP-2 a factor of safety of four is used in final plate qualification for both the wedge type and the shell type anchors. Apparently, by requiring a factor of safety of five, the shell type anchor is being penalized for its typically brittle mode of failure while no reduction is required to account for yield load (load at which the load-deflection curve departs from a straight line) of wedge type anchors. For the wedge type anchor to reach ultimate, the anchor typically will exhibit considerable deflection (slip). This characteristic of 1/2" to 1-1/2" slip makes the ultimate capacity unusable for most anchorage systems which typically can only tolerate anchor movements in the range of 1/8" or less. However, the shell type anchor undergoes deflections of less than 1/8" to the ultimate load which means that this load capacity is truly available to the anchorage system. Thus, the advantages and disadvantages of each type anchor appear to cancel each other out.

In addition to the above reason a factor of safety of four for the shell type anchor is justified because of the extensive load test program performed on site. (See References 3, 13, and 15.)

2.2 TEST PROGRAM

The WNP-2 load test program was initiated to establish realistic design tensile allowables to ensure a minimum factor of safety of four in anchor installations existing at the time the Bulletin was issued and in all future anchor installations. All testing was performed by an independent testing agency using WNP-2 standard production concrete (4000 psi mix design) as the test medium.

Testing was conducted to determine the effects of different embedments, epoxies or amounts of expansion on shell type anchors and the effect of different embedment on wedge type anchors. This testing was required so that the ahchor allowables could be adjusted for these irregular conditions if found in installations existing prior to issuance of the bulletin.

In addition, anchors were installed in strict compliance with manufacturer's recommendations using standard construction techniques and tested to establish design tensile allowable for all anchors. These allowables were used for design of anchorage systems after the issuance of the Bulletin.

Five anchors of each configuration (i.e., different embedment or different amount of expansion) were tested. Each anchor was loaded incrementally until failure occurred. After each loading increment was added, the total slip with respect to the concrete for that load was recorded. The anchor was considered failed when one of the following occured: 1) The concrete failed, 2) The anchor body failed, or 3) The anchor slipped 1/8" with respect to the concrete.

The following is a listing of the different type of drilled in concrete anchors tested:

Anchors	No. Tested
Phillips Red Head	290
Hilti Drop-In	170
Hilti Kwik Bolt	60
Hilti Super Kwik Bolt	10
Parabolts	30

2.3 TEST RESULTS

The results of the tests are documented in References 3, 12, and 13. Typical failure modes were slip for Hilti Kwik Bolts, Hilti Super Kwik Bolts, and Parabolts, slip or anchor body failure for Phillips Red Heads and concrete failure for Hilti Drop-Ins. These test results confirm the typical brittle failure for shell type anchors (Red Heads and Drop-Ins) and considerable slip typical of wedge type anchors (Kwik Bolts, Super Kwik Bolts, and Parabolts) as previously discussed in Section 2.1.

These test data were used for establishing the ultimate and allowable tensile load values (Table II) used for the final qualification of flexible Seismic Category I pipe supports to satisfy the concerns of the Bulletin.

The results of these tests were used further to statistically establish that with a 95 percent confidence level less than 5 percent of the expansion bolts of the types tested will have an actual capacity smaller than their design load. This confidence level is as conservitive as the confidence level established by the NRC in Appendix A to the Bulletin, Revision 2, entitled, "Sampling Methods".

2.4 ALLOWABLE LOADS

2.4.1 WNP-2 Original Design Allowables Used by Contractors

The allowable design loads for expansion anchors used by contractors has changed during the course of the job. Initially, the contractors were directed to use a minimum factor of safety of four based on manufacturer's ultimate strength, but, this was subsequently changed and they were directed to use International Conference of Building Officials (I.C.B.O.) values (References #1 and #2) early in the job before any major work was accomplished. Values for ultimate tensile loads for WNP-2 were developed through the extensive field testing program discussed in Section 2.2. A comparison of these ultimate values and the I.C.B.O. values are shown in Table I. In general, the use of the I.C.B.O. values by the contractors was conservative.

2.4.2 Anchor Allowables Used For Final Plate Qualification

The allowable design loads for expansion anchors used for final plate qualification are based on the ultimate loads of the field testing program and a factor of safety of four and are shown in Table II.

2.5 FACTORS OF SAFETY

One of the major reasons for choosing high factors of safety is the uncertain installation practices and incomplete documentation of many facilities. At WNP-2, there have been rigorously specified installation procedures and documentation that check the requirements necessary to achieve proper installation. Also, programs were initiated in 1978 to verify the adequacy of all existing expansion anchors (see response to Action Item No. 4). Therefore, based on the extensive field testing of expansion anchors and the strict installation and inspection procedures for expansion anchors a factor of safety of four for both shell type and wedge type anchors is justified. In addition, the major conservatisms discussed in Section 1.7 serve to increase the factor of safety beyond a minimum of four.

NRC ACTION ITEM NO. 3

Describe the design requirements if applicable for anchor bolts to withstand cyclic loads (e.g., seismic loads and high cycle operating loads.

3.0 RESPONSE TO ACTION ITEM NO. 3

Preloading of bolts is required in the installation procedures for the installation of expansion bolts to assure that compression between the base plate and the concrete remains when subjected to cyclic loading, such as seismic loading and high cycle operating loading, so as to avoid fatigue failures or loosening of the expansion bolt assembly due to cyclic loading variations. All expansion bolts are required to be torqued so as to provide a preload greater than the allowable tensile load, or as noted in Table III. This preload requirement assures that the bolt will be subjected only to small stress differences due to changes in load.

In the presented example of Action Item No. 1, for the eight bolt pattern, the maximum stress differences amount to only 6 percent of the ultimate strength of the bolt. In the case of the four bolt patterns, the maximum stress differences amount to only 2 percent of the ultimate strength of the bolt.

In conclusion, the prescribed preload is the design requirement that allows the expansion bolt assemblies to carry cyclic loads, without fatigue failure.

NRC ACTION ITEM NO. 4

Verify from existing QC documentation that design requirements have been met for each anchor bolt in the following areas:

(a) Cyclic loads have been considered (e.g., anchor bolt preload is equal to or greater than bolt design load). In the case of the shell type, assure that it is not in contact with the back of the support plate prior to preload testing.

(b) Specified design size and type is correctly installed (e.g., proper embedment depth).

If sufficient documentation does not exist, then initiate a testing program that will assure that minimum design requirements have been met with respect to subitems (a) and (b), above. A sampling technique is acceptable. One acceptable technique is to randomly select and test one anchor bolt in each base plate (i.e., some supports may have more than one base plate). The test should provide verification of subitems (a) and (b), above. If the test fails, all other bolts, on that base plate should be similarly tested. In any event, the test program should assure that each Seismic Category I system will perform its intended function.

The preferred test method to demonstrate that bolt preload has been accomplished is using a direct pull (tensile test) equal to or greater than design load. Recognizing this method may be difficult due to accessibility in some areas an alternative test method such as torque testing may be used. If torque testing is used, it must be shown and substantiated that a correlation between torque and tension exists. If manufacturer's data for the specific bolt used is not available, or is not used, then site specific data must be developed by qualification tests.

Bolt test values of one-fourth (wedge type) or one-fifth (shell type) of bolt ultimate capacity may be used in lieu of individually calculated bolt design loads where the test value can be shown to be conservative.

The purpose of Bulletin No. 79-02 and this revision is to assure the operability of each Seismic Category I piping system. In all cases an evaluation to confirm system operability must be performed. If a base plate or anchor bolt failure rate is identified at one unit of a multi-unit site which threatens operability of safety-related piping systems of that unit, continued operation of the remaining units at that site must be immediately evaluated and reported to the NRC. The evaluation must consider the generic applicability of the identified failures.

Appendix A describes two sampling methods for testing that can be used. Other sampling methods may be used but must be justified. Those options may be selected on a system by system basis.

Justification for omitting certain bolts from sample testing which are in high radiation areas during an outage must be based on other testing or analysis which substantiates operability of the affected system.

Bolts which are found during the testing program not to be preloaded to a load equal to or greater than bolt design load must be properly preloaded or it must be shown that the lack of preloading is not detrimental to cyclic loading capability. Those licensees that have not verified anchor bolt preload are not required to go back and establish preload. However, additional information should be submitted which demonstrates the effects of preload on the anchor bolt ultimate capacity under dynamic loading. If it can be established that a tension load on any of the bolts does not exist for all loading cases then no preload or testing of the bolts is required.

If anchor bolt testing is done prior to completion of the analytical work on baseplate flexibility, the bolt testing must be performed to at least the original calculated bolt load. For testing purposes, factors may be used to conservatively estimate the potential increase in the calculated bolt load due to baseplate flexibility. After completion of the analytical work on the baseplates the conservatism of these factors must be verified.

For baseplate supports using expansion anchors, but raised from the supporting surface with grout placed under the baseplate, for testing purposes it must be verified that leveling nuts were not used. If leveling nuts were used, then they must be backed off such that they are not in contact with the baseplate before applying tension or torque testing.

Bulletin No. 79-02 required verification by inspection that bolts are properly installed and are of the specified size and type. Parameters which should be included are embedment depth, thread engagement, plate bolt hole size, bolt spacing, edge distance to the side of a concrete member and full expansion of the shell for shell type anchor bolts.

If piping systems 2 1/2 inches in diameter or less were computer-analyzed then they must be treated the same as the larger piping. If a chart analysis method was used and this method can be shown to be highly conservative, then the proper installation of the baseplate and anchor bolts should be verified by a sampling inspection. The parameters inspected should include those described in the preceding paragraph. If small diameter piping is not inspected, then justification of system operability must be provided.

4.0 RESPONSE TO ACTION ITEM NO. 4

4.1 INTRODUCTION

Seismic Category I piping system supports have been installed with drilled-in concrete anchors at WNP-2 since about 1976. Our response to this action item addresses our program to assure compliance with the requirements of the Bulletin for those anchors installed prior to July 1979 when definitive inspection requirements were first issued in Revision 1 of the Bulletin. Those anchors installed after the issuance of the Bulletin are discussed in our response to Action Item No. 9. It is noted here that the evaluation of the design adequacy and the installation verification of all small diameter pipe supports are addressed in the same manner as large diameter pipe supports.

The specific requirements of the Action Item are presented as follows: Anchor bolt preloading is addressed first and is followed by a discussion of leveling nuts and a discussion of verification of existing installations according to contract.

4.2 ANCHOR BOLT PRELOADING

A specific requirement of the Bulletin is ". . . anchor bolt preload is equal to or greater than bolt design load." All WNP-2 contractors were directed by their original specifications to preload anchors to a value greater than design load. However, documentation for this preloading was not complete. To demonstrate that the anchors installed prior to issuance of the Bulletin were properly preloaded the method of torque testing recommended by the Action Item was selected.

4.2.1 Torque/Tension Testing

The Bulletin requires that site specific data must be developed by qualification tests which substantiate that a correlation between torque and tension exists. In response to the Bulletin requirement this testing was conducted at WNP-2 for Phillips Red Head, Hilti Drop-In, Hilti Kwik Bolt, and Hilti Super-Kwik Bolt anchors. These tests established the torque versus tension relationship for each anchor type and size. (Reference 12). Torque values for Molly Parabolt are those recommended by the manufacturer. They agree well with the test results for Hilti Kwik Bolts, a similar type anchor. Molly Parabolts had very limited usage on the project. The torque values, given in Table III, were utilized by all WNP-2 Contractors to preload anchors.

The testing confirmed the installation torques being used gave preloads ranging between 100 and 300 percent of the anchor allowable tension load, for all anchors except the 3/4 inch diameter Hilti Drop-In. The torque value for this anchor was increased to provide the required preload. Installations using these anchors which were installed prior to issuance of the Bulletin were retorqued. (See Exhibit A.)

4.2.2 Anchor Retorquing Program

As a result of document deficiencies concerning C215 torque wrench calibration and to further insure the integrity of their anchor installations all C215 Seismic Category I anchors are being retorqued. (Reference 14) The anchors of the other contractors that installed Seismic Category I pipe supports (C213, C216, C217, and C220) have been excluded from this program because most were installed and all have been torqued after the implementation of the Bulletin requirements. See Section 4.4.6, for a discussion of the Parabolts installed by C233.

4.3 LEVELING NUTS

A specific requirement of the Bulletin is ". . . it must be verified that leveling nuts were not used. If leveling nuts were used, then they must be backed off . . ."

At WNP-2, two contractors installed leveling nuts under some Seismic Category I floor mounted pipe supports installed prior to August 1979. They were C215 and C216. After August 1979, their usage was prohibited for all new base plate installations, regardless of Seismic Category. (See Exhibit B.) All of the Seismic Category 1 installations performed by C216 have been reworked to remove or back off the leveling nuts. This rework included torqueing the anchor bolts to their full preload (see Table III) and inspecting for anchor pull-up, before regrouting the plates. Anchors which did pull-up were replaced.

Leveling nuts installed by C215 are being reworked in a similar manner. However, one exception is being permitted. Base plates which are already grouted and the anchor tension loads do not exceed 10 percent of their allowable tension load require no rework. An anchor tension load equal to 10 percent of its allowable load is only 2.5 percent of the anchors ultimate load. Engineering judgment dictates this small cyclic load will not be detrimental to the anchor performance.

4.4 VERIFICATION OF INSTALLATIONS

In addition to the anchor preload and leveling nut requirements just discussed, the Bulletin listed other specific items for the inspection of anchors: ". . . verification by inspection that bolts are properly installed and are of the specified size and type. Parameters which should be included are embedment depth, thread engagement, plate bolt hole size, bolt spacing, edge distance to the side of a concrete member and full expansion of the shell for shell type anchor bolts."; "In the case of the shell type, assure that it is not in contact with the back of the support plate. . . ".

Documentation of satisfactory compliance with these inspection items was not complete. As a result, a program of installation verificaton was established for each contractor to insure base plate installation was adequate and satisfied the concerns of the Bulletin. The inspection requirements were implemented for all Contractors, except C215, by the directive of Exhibit C. The directives issued to C215 are given in Exhibits D and E. These directives covered both those anchors installed prior to July 1979, when these inspection requirements were issued in Revision 1 of the Bulletin and those anchors installed after July 1979. The former anchors are discussed in this response and the latter anchors are discussed in the response to Action Item No. 9.

Following is a contract by contract presentation of the specific status of each verification program.

4.4.1 Contract 213A - Primary Containment

Contract 213A was responsible for the installation of Seismic Category I piping systems within Containment. Their supports were installed exclusively with Hilti Super Kwik Bolts. Anchor installations were begun in early 1978. All anchor installations have been or are being inspected, verified, and documented to show compliance with the requirements of the Bulletin in accordance with Exhibit C.

4.4.2 Contract 215 - Mechanical Equipment Installation and Piping

The C215 Anchor Inspection program developed to satisfy compliance with the Bulletin requirements consisted of three phases: a) reinspection of all anchors installed prior to February 1978; b) reinspection of a sample of the anchors installed between February 1978 and July 1979; and c) inspection of all anchors during installation, after July 1979. The first two of these are discussed here because they pertain to anchors installed prior to issuance of the Bulletin. The third is addressed in our response to Action Item No. 9 of the Bulletin. In addition, a second program was initiated which prohibited the use of leveling nuts after August 1979 and required their removal from most existing Seismic Category I base plates. This was discussed in Section 4.3.

The first phase was devoted to a reinspection of all of the anchors installed prior to February 1978. (See Exhibit E.) During this period, the contractor installed Phillips Red Head Self-Drilling shell-type anchors and Hilti Kwik Bolt stud-type anchors. While this reinspection was initiated approximately one year before definitive inspection requirements were established by the Bulletin, it included all of the Bulletin inspection items, except three. (See the Table 4.1.) These items were plate bolt hole size, edge distance to the side of a concrete member and shell type anchor in contact with the back of the plate. When Revision 1 of the Bulletin was issued in July 1979 giving specific inspection requirements, the retroinspection program was revised to include all of them. Prior to implementation of this revision approximately seventy supports which utilized anchors were inspected; approximately sixty of these were installed with Red Head anchors and the remainder with Kwik Bolts.

While these three items were not specifically required as retroinspection items the contractor had installation criteria for them.

Plate Bolt Hole Size was controlled by the American Institute of Steel Constructors and/or American Society of Mechanical Engineers codes as required by the Specification. These codes provided for the maximum plate bolt hole size as a function of bolt diameter and plate thickness. Further, the contractor specified hole size on the base plate drawing and inspected for it as part of the as-built hanger inspections.

Contract 215 Anchor Retrospection Program
For Anchors Installed Prior to February 1978

Bulletin 79-02 - Inspection Item	Initial Direction Issued June 1978		Revised Direction Issued July 1979	
	PRH	HKB	PRH	HKB
Torque	X	X	X	X
Leveling Nuts	(1)	(1)	(1)	(1)
Specified Size	X	X	X	X
Specified Type	X	X	X	X
Embedment Depth	(2)	X	(3)	X
Thread Engagement	X	X	X	X
Plate Bolt Hole Size	---	---	X	X
Bolt Spacing	X	X	X	X
Edge Distance (Concrete)	---	---	X	X
Full Expansion of Shell	X(4)	N/A	X(4)	N/A
Pulled Against Plate	---	N/A	X	N/A

PRH = Phillips Red Head Self-Drilling shell type anchor

HKB = Hilti Kwik Bolt wedge type anchor

X = Anchor was inspected for compliance with this Bulletin item

(1) = See Section 4.3 of the response to Action Item No. 4

(2) = Required to be flush or below the concrete

(3) = Required to be 1/16 to 3/8 inch below the concrete

(4) = Inspected to expansion requirements established by the Engineer

TABLE 4.1

Edge Distance to the Side of a Concrete Member was controlled for all anchors by the requirements of the International Conference of Building Officials (ICBO) as required by the Specification. ICBO provided for the anchor edge distance as a function of the anchor diameter. It also gave a method for reducing the anchor allowable load should the edge distance be less than required.

Shell Type Anchor in Contact With the Back of the Plate was partially controlled by the requirements of ICBO as given by the Specification and by the retroinspection program requirements. It was required that the Phillips Red Head Self Drilling anchors be flush or below the concrete surface. Further, both the Specification and the retroinspection program required the anchors to be preloaded by torquing. Thus, the anchors were first installed flush with the concrete surface, in accordance with ICBO, and torqued, in accordance with the Specification requirement. Then in accordance with the retroinspection program, the bolts were untorqued and removed. The anchors were inspected for proper expansion, proper embedment (i.e., flush or below the concrete surface), proper torque and the other items listed in Table 4.1. It is extremely unlikely that an anchor which was loose enough in the hole to pull against the plate, could also meet the expansion and torque requirements of the retroinspection program. This is borne out by the fact that severly underexpanded anchors tended to turn freely when being torqued or untorqued. Further, the results of the retroinspection program carried out on supports after the inspection for pull-up was included showed far fewer violations than allowed by the accepted NRC statistical sampling method. (See Exhibit F.)

The conclusion is that even though these three inspection items were not included for the first seventy supports of the retroinspection program, the inspections performed did insure the anchor installations are adequate.

The second phase of the C215 Anchor Inspection Program is devoted to a retroinspection of a sample of the Seismic Category I anchors installed between February 1978 and July 1979. (See Exhibit F.) This includes the anchors installed after the time period covered by the 100 percent retroinspection program, described above, but before the issuance of the Bulletin inspection requirements. During this period, the contractors anchor inspection requirements evolved to include all of those specified in the Bulletin.

The initial sample size for this retroinspection program was selected to be in conformance with the accepted NRC statistical sampling method. The program consists of a review of the selected anchor inspection records. In this review, the actual anchor inspection items will be compared with those required by the Bulletin. A field inspection will then be performed on one anchor per base plate, for the Bulletin items not previously checked.

Based upon these inspection results the sample size will be adjusted in accordance with the NRC statistical sampling method, if necessary, in order to show all Seismic Category I anchors installed during the specified period meet the Bulletin requirements. Those not in compliance will be reworked and reinspected.

The final phase of the C215 Anchor Inspection Program involves new installations performed after July 1979. At this time, the contractor was directed to inspect 100 percent of his Seismic Category I installations to all of the requirements of the Bulletin. (See Exhibit C.) This program is fully discussed in our response to Action Item No. 9.

4.4.3 Contract 216 - HVAC and Plumbing Installation

Contract 216 was primarily responsible for Heating, Ventilation, and Air Conditioning installation. However, two of the subcontractors installed Seismic Category I piping. The piping supports were installed with Hilti Drop-In and Hilti Kwik Bolt anchors. All inspections were performed after July 1979 and are documented to show compliance with the requirements of the Bulletin. (See Exhibit C.)

4.4.4 Contract 217 - Fire Protection Systems

Contract 217 was responsible for the installation of Seismic Category I fire protection system piping. The piping supports were installed exclusively with Hilti Drop-In anchors. All installations were performed after May 1980. The anchor inspections are documented to show compliance with the requirements of the Bulletin. (See Exhibit C.)

4.4.5 Contract 220 - Instrument Installation

Contract 220 was responsible for the installation of Seismic Category I instrumentation control piping. The piping supports were installed exclusively with Hilti Drop-In anchors. Anchor installations were begun in early 1978. All anchor installations have been or are being inspected, reverified, and documented to show compliance with the requirements of the Bulletin. (See Exhibit C.)

4.4.6 Contract 233 - Spray Pond Piping

Contract 233 was responsible for the installation of Seismic Category I piping supports in the spray ponds. They installed approximately sixty base plates with Parabolts prior to implementation of the Bulletin requirements. Some of the base plates were cast in concrete rendering the anchors inaccessible for retroinspection. However, one bolt per base plate on the remaining accessible base plates is being retroinspected by C215 to show compliance with the Bulletin. (See Exhibit G.) Anchors which do not meet the retroinspection requirements are required to be reworked.

NRC ACTION ITEM NO. 5

Determine the extent that expansion anchor bolts were used in concrete block (masonry) walls to attach piping supports in Seismic Category I systems (or safety related systems in Seismic Category I systems (or safety related systems as defined by Revision 1 of IE Bulletin No. 79-02). If expansion anchor bolts were used in concrete block walls:

a. Provide a list of the systems involved, with the number of supports, type of anchor bolt, line size, and whether these supports are accessible during normal plant operation.

b. Describe in detail any design consideration used to account for this type of installation.

c. Provide a detailed evaluation of the capability of the supports, including the anchor bolts, and block wall to meet the design loads. The evaluation must describe how the allowable loads on anchor bolts in concrete block walls were determined and also what analytical method was used to determine the integrity of the block walls under the imposed loads. Also describe the acceptance criteria, including the numerical values, used to perform this evaluation. Review the deficiencies identified in the Information Notice on the pipe supports and walls at Trojan to determine if a similar situation exists at your facility with regard to supports using anchor bolts in concrete block walls.

d. Describe the results of testing of anchor bolts in concrete block walls and your plans and schedule for any further action.

5.0 RESPONSE TO ACTION ITEM NO. 5

By specification, no Seismic Class I piping system is to be attached to concrete block walls using expansion bolts. To provide further assurance that this specification requirement has been adhered to, all contractors installing piping were directed to review their installations and verify that expansion bolts have not been so used. This verification has been accomplished.

NRC ACTION ITEM NO. 6

Determine the extent that pipe supports with expansion anchor bolts used structural steel shapes instead of baseplates. The systems and lines reviewed must be consistent with the criteria of IE Builletin No. 79-02, Revision 1. If expansion anchor bolts were used as described above, verify that the anchor bolt and structural steel shapes in these supports were included in the actions performed for the Bulletin. If these supports cannot be verified to have been included in the Bulletin actions:

a. Provide a list of the systems involved, with the number of supports, type of anchor bolt, line size, and whether the supports are accessible during normal plant operation.

b. Provide a detailed evaluation of the adequacy of the anchor bolt design and installation. The evaluation should address the assumed distribution of loads on the anchor bolts. The evaluation can be based on the results of previous anchor bolt testing and/or analysis which substantiates operability of the affected system.

c. Describe your plans and schedule for any further action necessary to assure the affected systems meet Technical Specifications operability requirements in the event of an SSE.

6.0 RESPONSE TO ACTION ITEM NO. 6

Attachments of structural steel shapes directly to concrete with expansion bolts is mainly confined to supports for small diameter piping. Their use is very uncommon for large diameter piping. However, wherever they are used, their effects are being assessed in the same manner as all other flexible base plates (see Action Item No. 1).

NOTE: NRC Action Item No. 7 is not applicable to WNP-2 and NRC Action Item No. 8 requires no response.

NRC ACTION ITEM NO. 9

All holders of construction permits for power reactor facilities are requested to complete Items 5 and 6 for installed pipe supports within 60 days of date of issuance of Revision No. 2. For pipe supports which have not yet been installed, document your action to assure that Items 1 through 6 will be satisfied. Maintain documentation of these actions on site available for NRC inspection. Report in writing within 60 days of date of issuance of Revision No. 2, to the Director of the appropriate NRC Regional Office, completion of your review and describe any instances not previously reported, in which you did not meet the revised (R2) sections of Items 2 and 4 and, if necessary, your plans and schedule for resolution. A copy of your report should be sent to the United States Nuclear Regulatory Commission, Office of Inspection and Enforcement, Division of Reactor Construction Inspection, Washington DC 20555.

9.0 RESPONSE TO ACTION ITEM NO. 9

9.1 Introduction

The response to previous Action Items discussed in detail each affected contractors program for showing compliance with the Bulletin evaluation/ inspection requirements for installations made prior to its issuance. Installations performed after its issuance are discussed here.

9.2 Base Plate Analysis

All Seismic Category I large and small diameter pipe support base plates, for all affected contractors, are being evaluated and qualified in accordance with the requirements of the Bulletin, by the Engineer. Our response to Action Item No. 1 presents a detailed discussion of the analytical methodology being employed.

9.3 Generic Anchor Inspection Criteria

After Revision 1 of the Bulletin was issued in June 1979, generic inspection criteria was issued to all the contractors installing Seismic Category I large and small diameter piping supports. (See Exhibits C and D.) These criteria included all of the inspection requirements for anchor installations deliniated in the Bulletin. Anchor installations performed after this date have been and are being documented to show compliance with the Bulletin. Also, the usage of leveling nuts under base plates was prohibited by generic criteria issued in August 1979. (See Exhibit B.)

10.0 References

1. International Conference of Building Officials (I.C.B.O.), Report No. 2895, November 1976.

2. International Conference of Building Officials (I.C.B.O.), Report No. 1372, March 1973.

3. Noble, L. D., and Mead, W. M., Drilled-In Concrete Anchor Tests Performed at the Washington Public Power Supply System, Nuclear Project 2 Site, March 1979.

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7. Hanks, Abbot A., "Combined Shear and Tension Testing - Kwik Bolt", Report No. 9059, April 15, 1974.

8. DiLuna, L. J., and Flaherty, J. A., "An Assessment of the Effect of Plate Flexibility on the Design of Moment-Resistant Base Plates", ASME, August 1979.

9. Lysmer, et al., "FLUSH-A Computer Program for Approximate 3-D Analysis of Soil-Structure Interaction Problems", Report No. EERC 75-30, November 1975.

10. R. D. Clatto and R. R. Boentgen, "Strength of Concrete Expansion Anchors for Pipe Supports, Teledyne Engineering Services.

11. Chenault, D. M., "Rigid Plate Test Data Transmittal Report", June 1979, In-House Burns and Roe Report.

12. Chenault, D. M., "Torque-Load Tests in Drilled-In Concrete Anchors", August 1979, In-House Burns and Roe Report.

13. Hyde, L.L., Drilled-In Concrete Anchor Test Performed at the Washington Public Power Supply System, Nuclear Project 2 Site, Supplemental Report No.1, August 1979.

14. Bechtel Power Corporation, Task Force Study and Recommendations: Hanger and Anchor Bolt Report, Letter BECMCL-82-0032, January 18, 1982.

15. Chenault, D.M., Drilled-In Concrete Anchor Tests Performed at the Washington Public Power Supply System, Nuclear Project 2 Site, Supplemental Report No. 2, September 1979.

TABLE I

ALLOWABLE EXPANSION ANCHOR LOADS

Provided to Contractor

PHILLIPS RED HEAD SELF DRILLING - SHELL TYPE ANCHOR						
Size In.	WPPSS Ult. Tension KIPS	Allowed Tension KIPS	Factor Safety ---	Manu. Ult. Shear KIPS	Allowed Shear KIPS	Factor Safety ---
1/4	2.56	0.54	4.74	1.35	0.49	2.71
3/8	4.91	1.14	4.31	3.57	1.10	3.06
1/2	8.0	1.72	4.65	6.72	1.75	3.84
2/5	11.11	2.25	4.98	11.90	2.02	5.89
3/4	10.67	2.57	4.15	16.20	2.57	6.84
7/8	12.44	2.90	4.29	18.45	2.80	6.59

HILTI KWIK BOLT - WEDGE TYPE ANCHOR						
Size In.	WPPSS Ult. Tension KIPS	Allowed Tension KIPS	Factor Safety ---	Manu. Ult. Shear KIPS	Allowed Shear KIPS	Factor Safety ---
1/4X1-1/2	2.89	0.54	5.55	2.61	0.49	5.55
3/8X2	5.15	1.14	4.52	5.11	1.10	4.64
1/2X2-1/2	7.30	1.72	4.24	8.32	1.75	4.75
5/8X3-1/2	9.53	2.23	4.27	11.56	2.02	5.72
3/4X4	15.10	2.57	5.88	17.13	2.57	7.22

HILTI DROP IN - SHELL TYPE ANCHOR						
Size In.	WPPSS Ult. Tension KIPS	Allowed Tension KIPS	Factor Safety ---	Manu. Ult. Shear KIPS	Allowed Shear KIPS	Factor Safety ---
1/4	3.90	0.64	6.09	1.78	0.49	3.63
3/8	5.55	1.33	4.40	4.25	1.10	3.85
1/2	9.78	2.11	4.63	6.22	1.96	3.17
5/8	14.22	2.51	5.66	12.21	3.07	3.98
3/4	20.44	4.06	5.03	17.61	4.42	3.98

TABLE I (CONTD)
ALLOWABLE EXPANSION ANCHOR LOADS
Provided to Contractor

HILTI SUPER KWIK BOLT - WEDGE TYPE ANCHOR						
Size In.	WPPSS Ult. Tension KIPS	Allowed Tension KIPS	Factor Safety ---	Manu. Ult. Shear KIPS	Allowed Shear KIPS	Factor Safety ---
1/2 X 3-1/4	9.99	2.50	4.00	11.44	2.86	4.0
1/2 X 4-1/4	14.78	3.70	4.00	11.44	2.86	4.0
1/2 X 5-1/4	14.57	3.64	4.00	11.44	2.86	4.0
1/2 X 6-1/4	15.15	3.79	4.00	11.44	2.86	4.0
1 X 6-1/2	34.97	8.74	4.00	27.54	6.89	4.0
1 X 8-1/2	49.81	12.45	4.00	27.54	6.89	4.0
1 X 10-1/4	49.76	12.44	4.00	27.54	6.89	4.0
1-1/4X8-1/8	42.70	10.67	4.00	41.45	10.37	4.0
1-1/4X10-5/8	55.65	15.42	4.00	41.45	10.37	4.0

MOLLY PARABOLT - WEDGE TYPE ANCHOR						
Size In.	WPPSS Ult. Tension KIPS	Allowed Tension KIPS	Factor Safety ---	Manu. Ult. Shear KIPS	Allowed Shear KIPS	Factor Safety ---
1/2X2-1/4	4.61	1.15	4.0	7.35	1.15	6.4
5/8X2-3/4	7.76	1.94	4.0	13.50	1.49	9.1
3/4X3-1/4	12.90	3.23	4.0	21.75	2.10	10.4
7/8X4	18.75	4.50	4.0	30.00	2.75	10.9
1 X4-1/2	23.00	5.75	4.0	39.30	3.30	11.8
1-1/4X5-1/2	35.00	8.75	4.0	63.50	4.66	13.6

TABLE II

ALLOWABLE EXPANSION ANCHOR LOADS USED FOR FINAL BASE PLATE QUALIFICATION

PHILLIPS RED HEADS INSTALLED AFTER FEB. 1978

Size In.	Ultimate Tension kips	Allowable Tension kips	Ultimate Shear kips	Allowable Shear kips	Tensile Stiffness k/in.	Shear Stiffness k/in.
1/2	8.667	2.167	6.270	1.680	700	106
5/8	10.801	2.700	11.900	2.975	695	250
3/4	11.467	2.867	16.200	4.050	1460	302
7/8	14.134	3.533	18.450	4.612	1600	300

PHILLIPS RED HEADS INSTALLED BEFORE FEB. 1978

Size In.	Ultimate Tension kips	Allowable Tension kips	Ultimate Shear kips	Allowable Shear kips	Tensile Stiffness k/in.	Shear Stiffness k/in.
1/2	4.267	1.067	6.720	1.680	700	106
5/8	7.970	1.992	11.900	2.975	695	250
3/4	6.534	1.633	16.200	4.050	1460	302
7/8	11.601	2.900	18.450	4.612	1600	300

HILTI DROP IN

Size In.	Ultimate Tension kips	Allowable Tension kips	Ultimate Shear kips	Allowable Shear kips	Tensile Stiffness k/in.	Shear Stiffness k/in.
3/8	5.633	1.408	4.225	1.056	410	205
1/2	8.44	2.11	7.84	1.96	480	106
5/8	10.333	2.583	12.205	3.051	840	250
3/4	18.133	4.533	17.609	4.402	980	302

TABLE II (CONTD.)

HILTI KWIK BOLT

Size * In.	Ultimate Tension kips	Allowable Tension kips	Ultimate Shear kips	Allowable Shear kips	Tensile Stiffness k/in.	Shear Stiffness k/in.
1/2 x 2 1/2	5.52	1.38	8.32	2.08	220	106
1/2 x 4	9.10	2.27	8.32	2.08	412	106
5/8 x 3 1/2	9.08	2.27	11.56	2.89	900	250
3/4 x 4	10.12	2.53	17.08	4.27	900	250

HILTI SUPER KWIK

Size* In.	Ultimate Tension kips	Allowable Tension kips	Ultimate Shear kips	Allowable Shear kips	Tensile Stiffness k/in.	Shear Stiffness k/in.
1/2 x 3 1/4	9.9	2.475	11.44	2.86	300	180
1/2 x 4 1/4	14.78	3.695	11.44	2.86	285	180
1/2 x 5 1/4	14.57	3.642	11.44	2.86	271	180
1/2 x 6 1/4	15.15	3.788	11.44	2.86	259	180
1 x 6 1/2	34.97	8.742	27.536	6.884	1165	500
1 x 8 1/2	49.81	12.452	27.536	6.884	1057	500
1 x 10 1/2	49.758	12.439	27.536	6.884	967	500
1¼ x 8 1/2	42.7	10.675	41.479	10.370	2083	1000
1¼ x 10 5/8	53.68	13.42	41.479	10.370	1817	1000
1¼ x 13 1/8	64.992	16.23	41.479	10.370	1611	1000

MOLLY PARABOLT

Size* In.	Ultimate Tension kips	Allowable Tension kips	Ultimate Shear kips	Allowable Shear kips	Tensile Stiffness k/in.	Shear Stiffness k/in.
1/2 x 2 3/4	7.439	1.859	7.35	1.837	1040	106
3/4 x 3 1/4	12.90	3.225	21.75	5.437	1063	302
3/4 x 4 1/2	15.26	3.185	21.75	5.437	963	302
7/8 x 4 1/2	18.75	4.687	30.0	7.5	2556	300
7/8 x 4 7/8	21.667	5.417	30.0	7.5	1878	500
1 x 5 1/2	26.555	6.638	39.3	9.825	1766	500

* Size = Bolt diameter x embedment depth

TABLE III

WNP-2 EXPANSION ANCHOR INSTALLATION TORQUES AND PRELOADS

Anchor Type	Phillip Red Head Self Drilling	Hilti Kwik Bolt	Hilti Drop In	Hilti Super Kwik Bolt	Molly Parabolt
Size	Torque ft/lbs	Torque ft/lbs	Torque ft/lbs	Torque ft/lbs	Torque ft/lbs
1/4	4 - 6	4 - 6	4 - 6	N/A	N/A
3/8	15 - 20	25 - 35	15 - 20	N/A	N/A
1/2	30 - 35	45 - 55	30 - 35	80 - 85	45 - 65
5/8	55 - 60	80 - 90	55 - 60	N/A	80 - 90
3/4	75 - 80	125 - 175	130 - 140	N/A	125 - 175
7/8	95 - 100	N/A	N/A	N/A	165 - 210
1	N/A	N/A	N/A	345 - 380	250 - 300
1 1/4	N/A	N/A	N/A	720 - 790	400 - 500

Size	Average Preload KIPS	Average Preload KIPS	Average Preload KIPS	Average Preload KIPS	Average Preload KIPS
1/4	0.63	1.23	0.63	N/A	N/A
3/8	1.51	3.79	1.51	N/A	N/A
1/2	2.25	2.80	2.4	2.45	2.77
5/8	3.2	4.45	3.24	N/A	4.66
3/4	3.2	8.47	5.80	N/A	7.74
7/8	4.8	N/A	N/A	N/A	11.3
1	N/A	N/A	N/A	15.3	13.8
1-1/4	N/A	N/A	N/A	20.8	21.0

EIGHT BOLT TEST PLATE

TEST 1,2,3

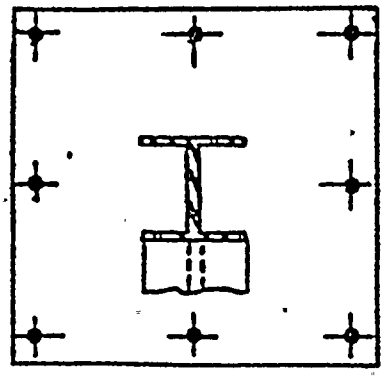


PLATE 1" x 21" x 1'9"

W 6 x 25 ATTACHMENT

SIX BOLT TEST PLATE

TEST 4

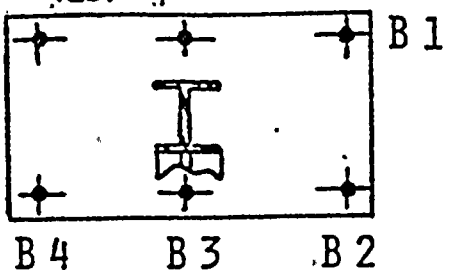


PLATE 1" x 12" x 1'9"

W 4 x 13 ATTACHMENT

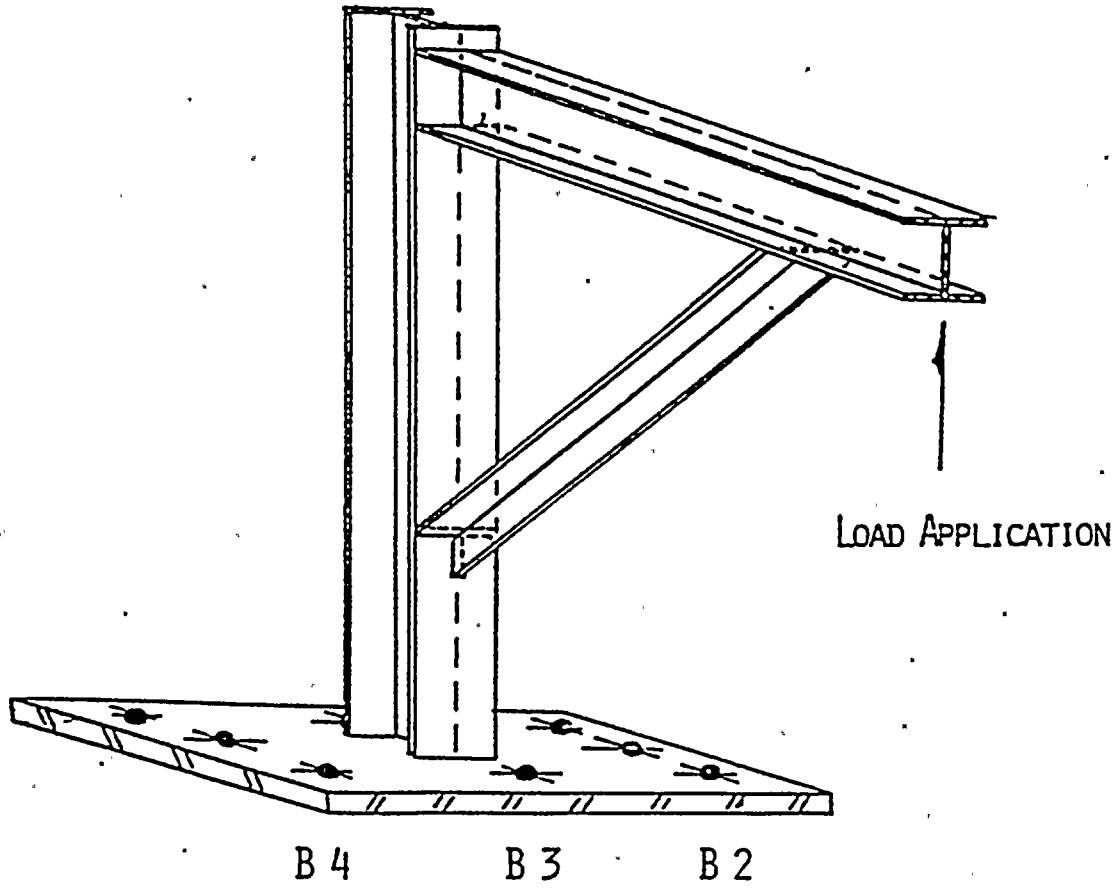


FIGURE 1. FIELD TEST

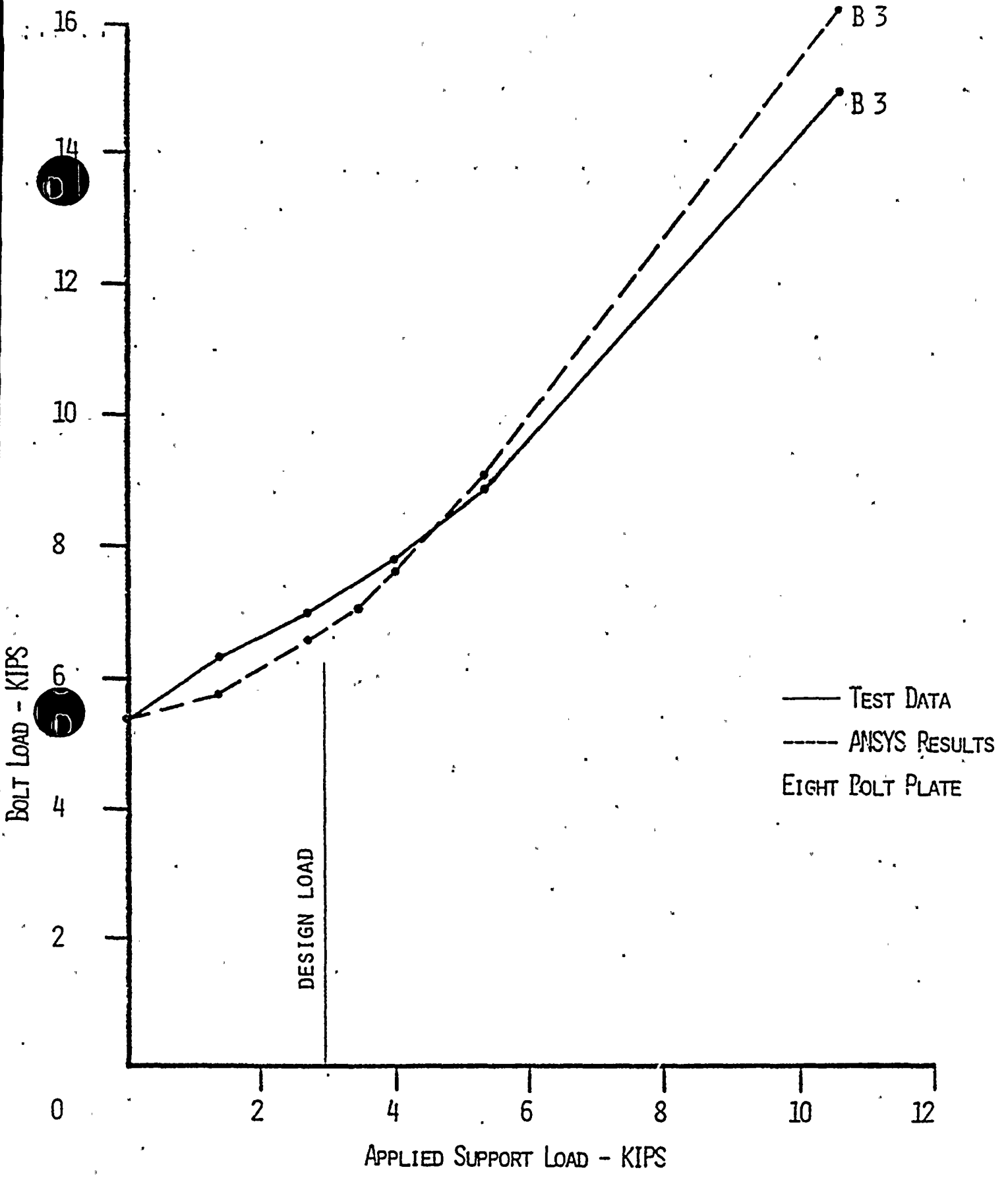


FIGURE 11 - BOLT LOAD COMPARISON FOR TEST 1

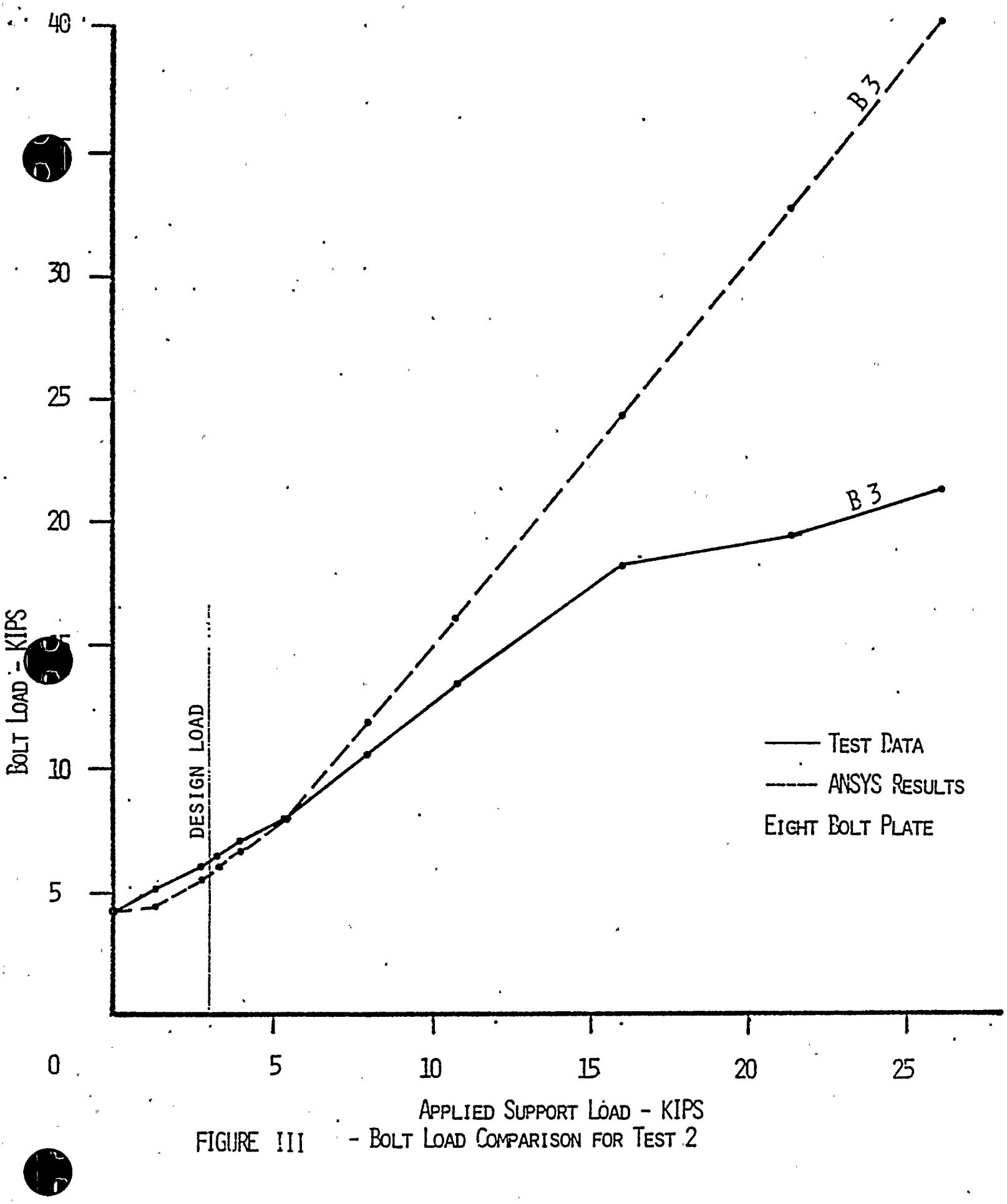


FIGURE III - BOLT LOAD COMPARISON FOR TEST 2

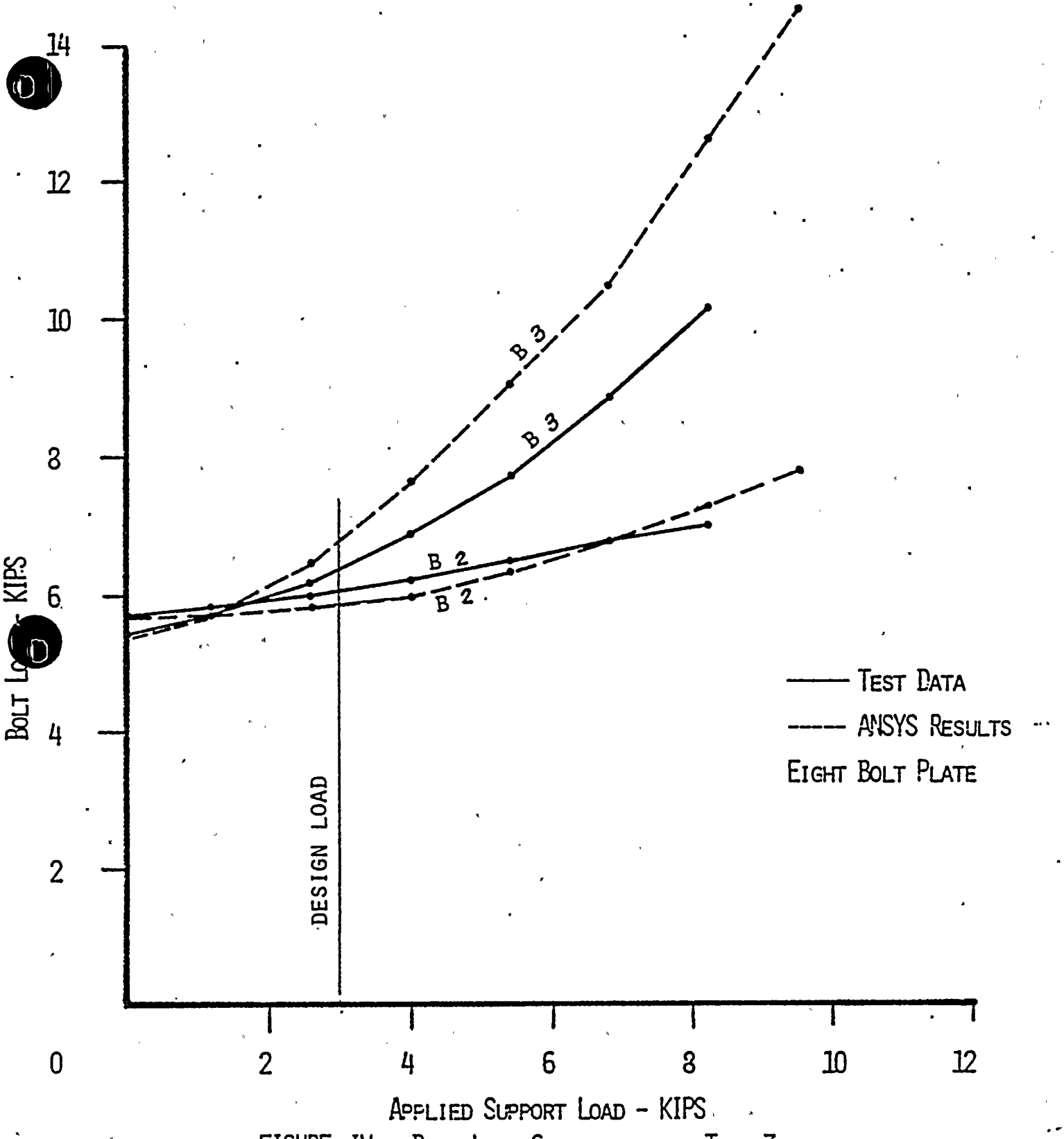


FIGURE IV - BOLT LOAD COMPARISON FOR TEST 3

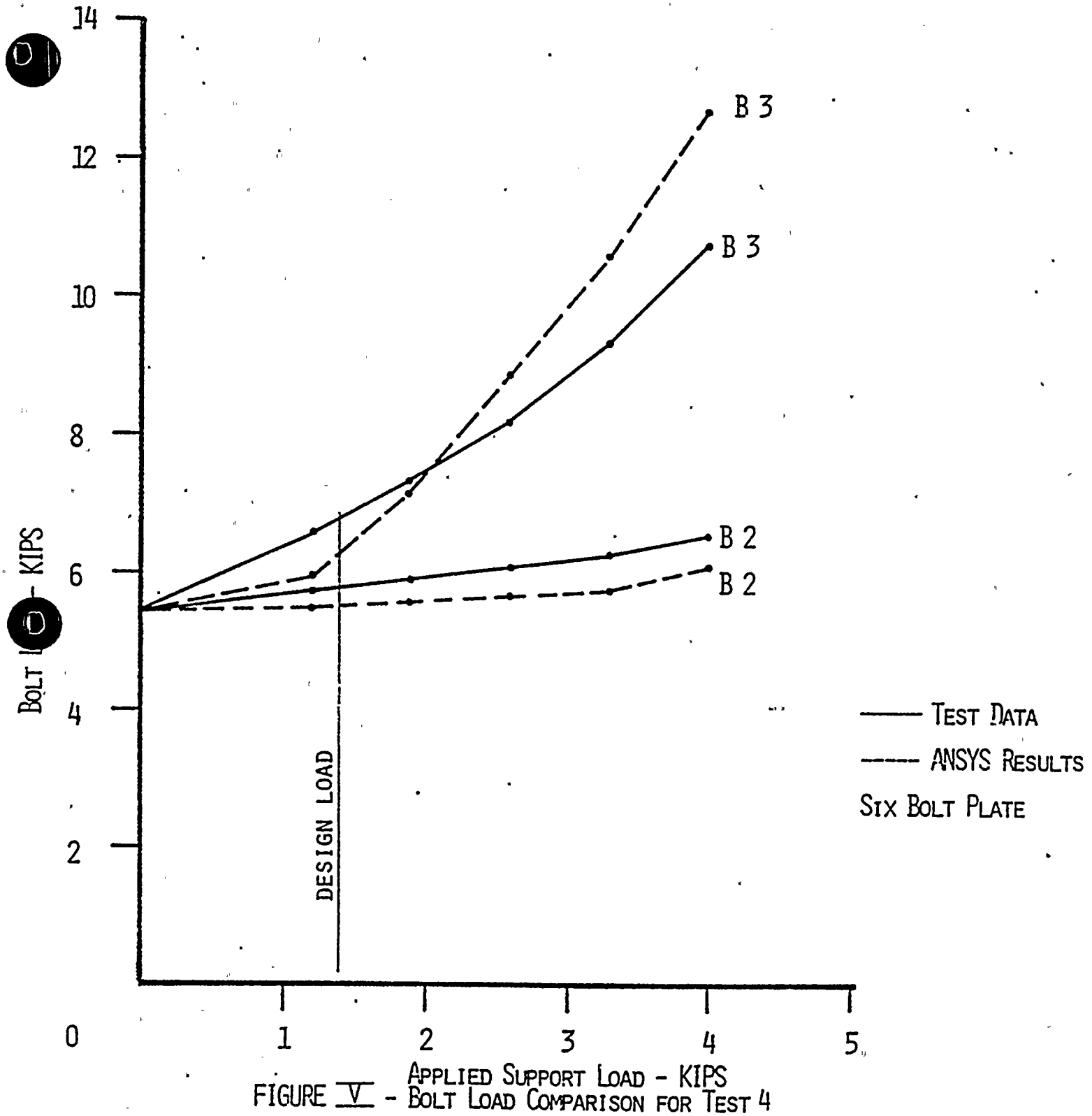


FIGURE V - BOLT LOAD COMPARISON FOR TEST 4

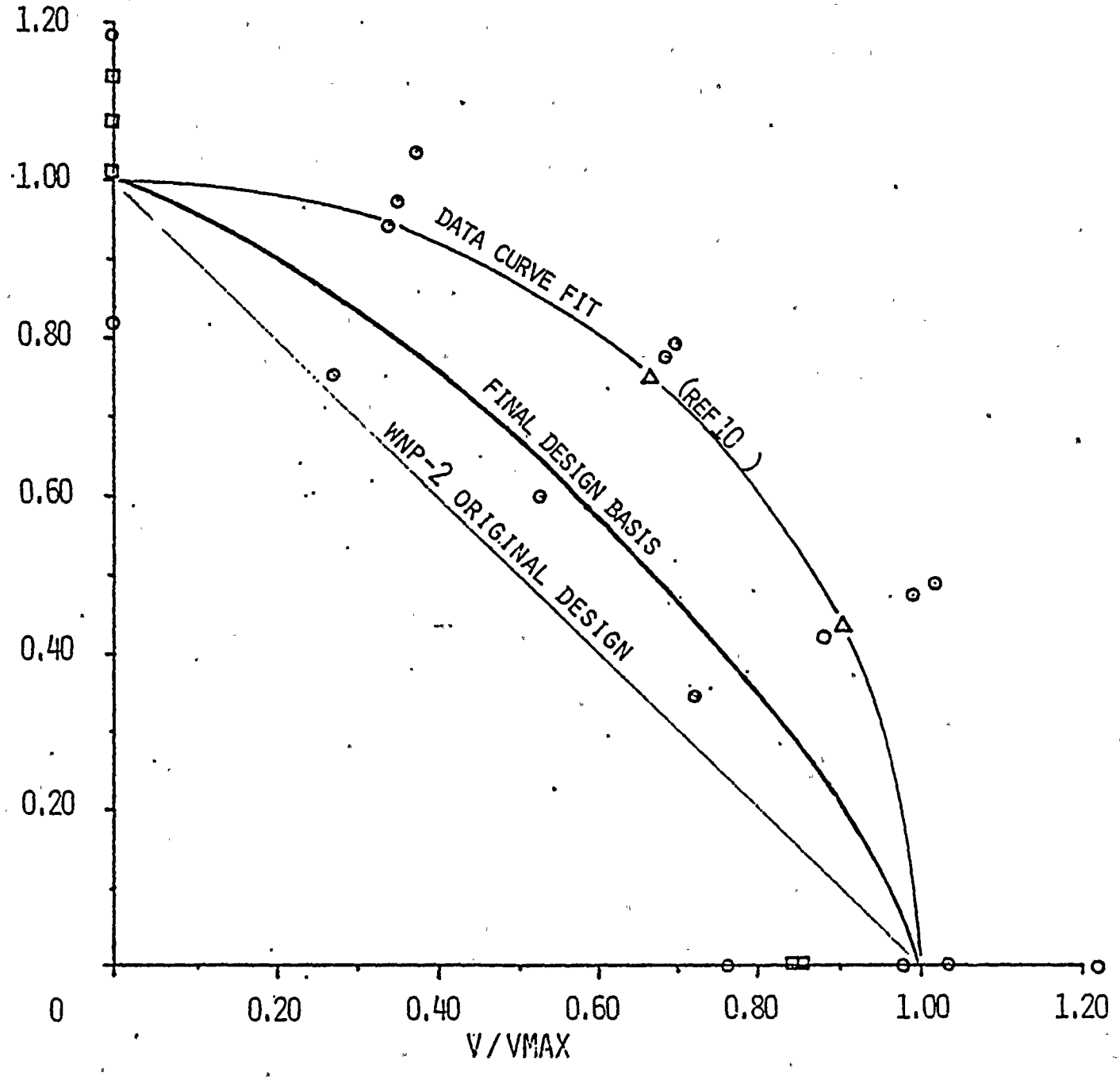


FIGURE VI SHEAR - TENSION INTERACTION DIAGRAM

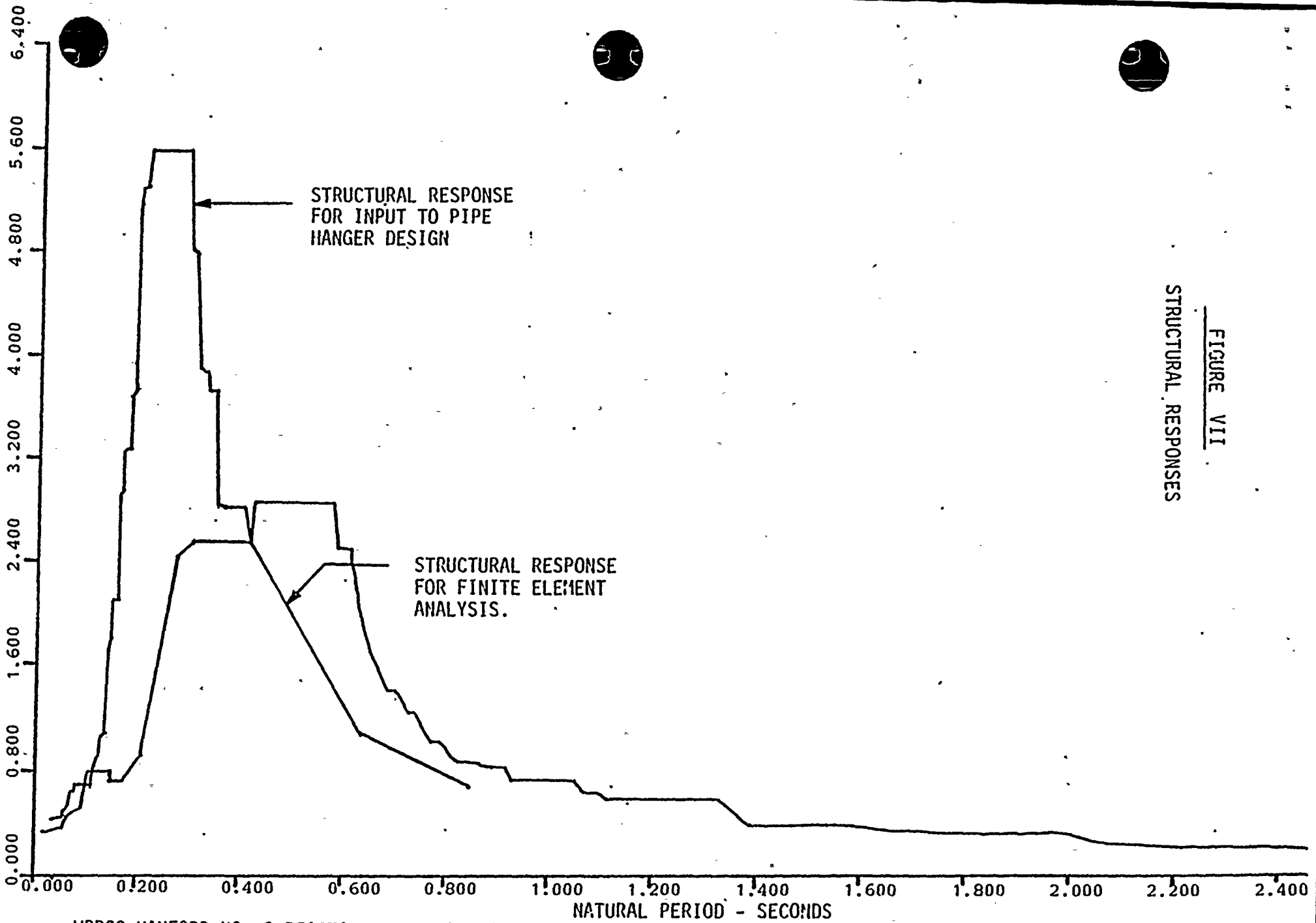


FIGURE VII

STRUCTURAL RESPONSES

WPPSS HANFORD NO. 2 REACTOR BUILDING, MODEL NO. 2 REV. 1
SSE (DBE) FLOOR SPECTRUM - COMBINED VERTICAL
MASS NO. 10, EL. 414' -3.0". DAMPING = 0.005

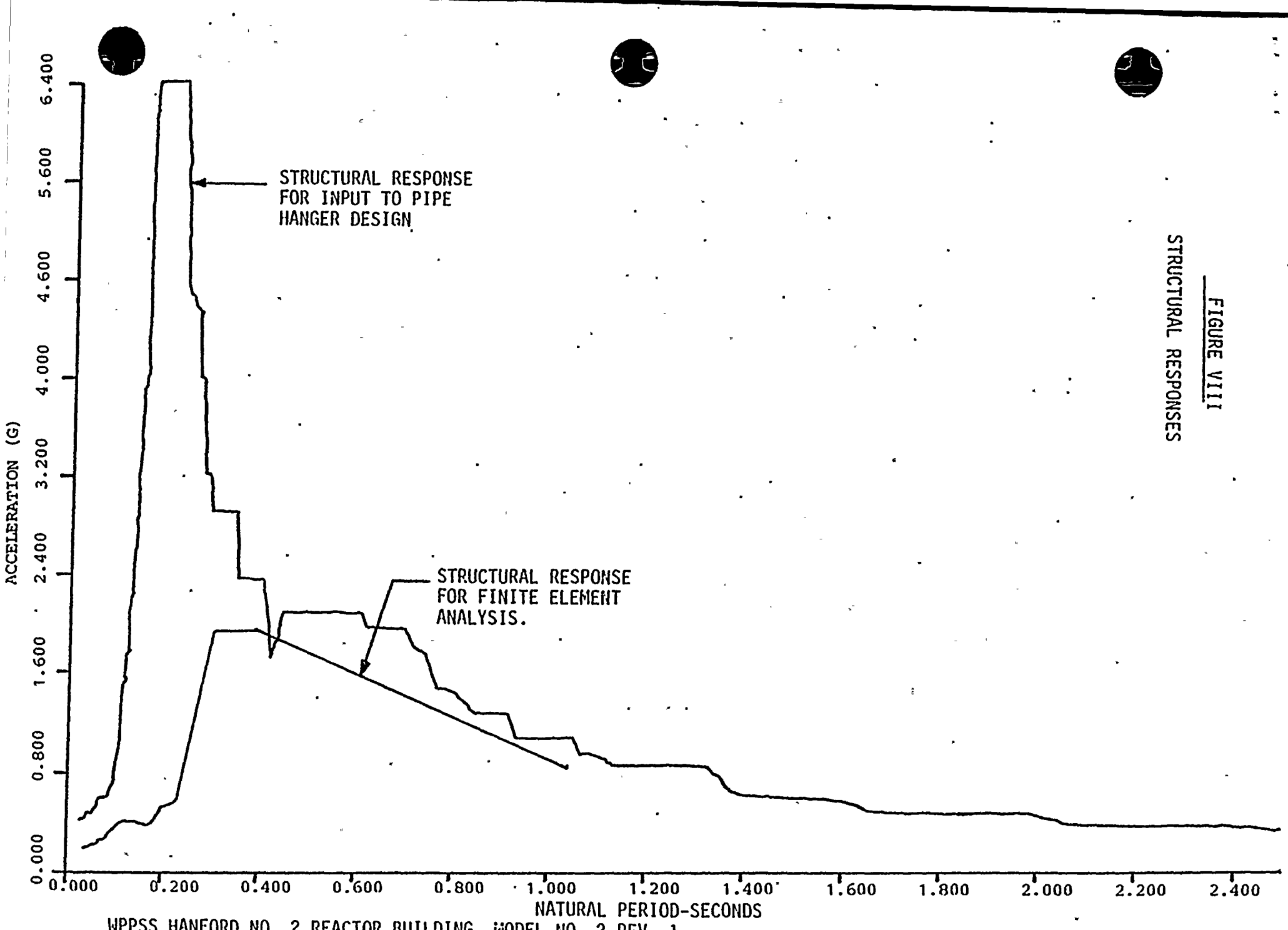


FIGURE VIII

STRUCTURAL RESPONSES

WPPSS HANFORD NO. 2 REACTOR BUILDING, MODEL NO. 2 REV. 1
SSE (DBE) FLOOR SPECTRUM - HORIZONTAL
MASS NO. 10, EL. 414'-3.0". DAMPING = 0.005

EXHIBIT A

3/4 INCH HDI TORQUE VALUES

This exhibit is referenced in paragraph 4.2.2 of the response to the Bulletin.

The vehicle that is used at WNP-2 to provide engineering instructions to Contractors is a Project Engineering Directive (PED). Even though generic instructions are issued which affect several contractors each contractor receives a PED with a unique number.

This exhibit consists of the PED issued to Contract 215. However, the instructions are generic and were issued to all affected contractors by the following PEDs:

Contract 213A	Not applicable
Contract 215	215-CS-1214
Contract 216	216-CS-0345
Contract 217	217-CS-0043
Contract 220	220-CS-0260

BURNS AND ROE, INC.
WPPSS
NUCLEAR PROJECT
NO. 2

PROJECT ENGINEERING DIRECTIVE

21 | 21S | -CS- | 12 | 4

DATE 08/15/79 PRIORITY 1

INFORMATION CONTRACTORS N/A

SHEET 1 OF 2

REASON FOR P.E.D.:

To revise the required torque values for the 3/4" diameter Hilti Drop-In (HDI) concrete anchor.

Recent torque vs. tension tests performed on the HDI anchors in response to I.E. Bulletin 79-02 has shown that the required torque is too low.

REVISED BY PED 218-CS-1257

REFERENCES

SUBJECT NEW TORQUE VALUES FOR HDIs

LOCATION IN PLANT

ENG. SYSTEM —

S/U SYSTEM —

QUALITY CLASS I, II E.G

ORIGINATING —

DOCUMENTS —

REVISE

REFERENCE DRAWINGS

DRAWING NO. – SHEET NO. – SUFFIX – REV.

REVISE

REFERENCE SPEC. PARAGRAPHS

PARAGRAPH PAGE REV.

DESCRIPTION OF WORK:

Contractor is to revise his installation procedures to incorporate the new torque required for the 3/4" diameter Hilti Drop-In. The new value is given below.

	Torque (ft-lbs.)	
	Old	New
3/4" Hilti Drop-In anchor	75-80	130-140

All 3/4" diameter HDIs installed from Sept. 1, 1979 on shall be torqued to the new value.

All previously installed 3/4" diameter HDIs must be retorqued unless it can be shown that they meet the criteria below.

The following 3/4" HDI anchors need not be retorqued to the new values.

1) 3/4" HDIs directly substituted for 3/4" & smaller Phillips Red Head Self Drilling anchors or 3/4" or smaller Hilti Kwik Bol 65536

NOTES

1. THIS PED REVISES DIRECTION PREVIOUSLY PROVIDED BY N/A THE FOLLOWING PED(s): —

2. THIS PED WORK SHOULD BE COORDINATED WITH KNOWN OTHER CONTRACTOR WORK UNDER THE FOLLOWING PED'S: N/A

3. THIS PED DEPENDS ON THE PRIOR INSTALLATION OF THE FOLLOWING PED'S. N/A

APPROVALS:

DISCIPLINE ENGINEER — DATE 8/17/79

LEAD ENGINEER — DATE 8/19/79

COG CONTRACT ENGR. — DATE 8/21/79

S/U LIAISON ENGR. — DATE 8/22/79

RESIDENT PROJ. ENGR.

Exhibit A.

If a contractor elects not to retorque any of these HDIs, he must compile a list of the supports on which no retorquing will be done. This list shall be furnished to B & R Engineering by Jan. 4, 1980.

On supports installed prior to Sept. 1, 1980, this PED applies only to HDI anchors which are Quality Class I (and Quality Class II & G which are Seismic Class I).

The retorquing is to be verified and documented by QC.

C 65537

REF DOC PCN ——	RFI —		WPPSS NUCLEAR PROJECT NO. 2
REF SPEC SECTION —	PAGE: —	PARA: —	BURNS AND ROE, INC.
REF DWG ——		DWG. ZONE: —	PED 215-CS-1214 SHT 2 OF 2
SCALE.	DRAWN BY DJA DATE 8/15/79	REVIEWED JRS DATE 8/17	TITLE: NEW TORQUE VALUES FOR HDIs Exhibit A
	CHKD BY JRS DATE 8/17/79	APPVD [illegible] DATE 8/19/79	

EXHIBIT B

LEVELING NUTS

This exhibit is referenced in paragraphs 4.3 and 9.3 of the response to the Bulletin.

The vehicle that is used at WNP-2 to provide engineering instructions to Contractors is a Project Engineering Directive (PED). Even though generic instructions are issued which affect several contractors each contractor receives a PED with a unique number.

This exhibit consists of the PED issued to Contract 215. However, the instructions are generic and were issued to all affected contractors by the following PEDs:

	August 1979	December 1979
Contract 213A	NA	213A-CS-0198
Contract 215	215-CS-1194	215-CS-2075
Contract 216	216-CS-0355	216-CS-0381
Contract 217	217-CS-0050	217-CS-0084
Contract 220	220-CS-0265	220-CS-0320

BURNS AND ROE, INC.
WPPSS
NUCLEAR PROJECT
NO. 2

PROJECT ENGINEERING DIRECTIVE

CODE	PROJECT ENGINEERING DIRECTIVE
21	215 - C5 - 1194
DATE	08/13/79
PRIORITY	I

INFORMATION CONTRACTORS 215

SHEET 1 OF 1

REASON FOR P.E.D.:

To inform contractor that the use of leveling nuts on floor mounted base plates utilizing drilled in concrete anchors will no longer be permitted.

INFORMATION COPY

DESCRIPTION OF WORK:

This PED applies to all floor mounted supports that have not yet been grouted.

The contractor should revise the appropriate procedures to reflect this modification.

REVISED BY PED 215-C-1194 215-C5-1194

C 65326

REFERENCES

SUBJECT	LEVELING NUTS/BASE PLATES
LOCATION	IN PLANT
ENG. SYSTEM	—
S/U SYSTEM	—
QUALITY CLASS	I, II & G
ORIGINATING DOCUMENTS	I. E. BULLETIN 79-02

REVISE

REFERENCE DRAWINGS

DRAWING NO.	SHEET NO.	SUFFIX	REV.

REVISE

REFERENCE SPEC. PARAGRAPHS

	PARAGRAPH	PAGE	REV.
N	4.3	15A-17A	01

NOTES

1. THIS PED REVISES DIRECTION PREVIOUSLY PROVIDED BY THE FOLLOWING PED(s): N/A
2. THIS PED WORK SHOULD BE COORDINATED WITH KNOWN OTHER CONTRACTOR WORK UNDER THE FOLLOWING PED'S: N/A
3. THIS PED DEPENDS ON THE PRIOR INSTALLATION OF THE FOLLOWING PED'S: N/A

APPROVALS:

D Karanian for DISCIPLINE ENGINEER	8/13/79 DATE
Suresh Mehta LEAD ENGINEER	8/13/79 DATE
C.C. Lee COG. CONTRACT ENGR.	8/15/79 DATE
S/U LIAISON ENGR.	8/15/79 DATE
RESIDENT PROJ. ENGR.	

Exhibit B

BURNS AND ROE, INC.
WPPSS
NUCLEAR PROJECT
NO. 2

PROJECT ENGINEERING DIRECTIVE

CODE: 211 | PROJECT ENGINEERING DIRECTIVE: 2151 – CS – 20175

DATE: 12/11/79 | PRIORITY: I

INFORMATION CONTRACTORS: NA | SHEET 1 OF 11

REASON FOR P.E.D.:

To provide instructions and procedure to contractor regarding modification of floor mounted base plates which utilized leveling nuts. And to provide a procedure for installation of base plates mounted directly on the floor.

Also included is the basic guidelines for obtaining adequate bearing contact for other than floor supports (i.e. wall and ceiling).

REVISED BY PED 215-CS-7910
215-CS-8717

DESCRIPTION OF WORK:

The attached procedure provides the basic requirements for the work described below. Contractor shall submit a procedure for approval using the attached procedure as a guide.

The following subjects are addressed in the attached procedure.

1. General Notes
2. Correcting previously installed (and grouted) base plates utilizing leveling nuts.
3. Correcting previously installed (and ungrouted) base plates utilizing leveling nuts.
4. Installing floor mounted base plates directly on the floor. (No grout pad).
5. Shimming Base Plates.
6. Grouting Base Plates C 68829
7. Replacing failed anchors.
8. Grouting criteria for wall and ceiling supports.

REFERENCES

SUBJECT: Floor Mounted Base Plates
LOCATION: In Plant
ENG. SYSTEM: Varies
S/U SYSTEM: Varies
QUALITY CLASS: I, II, & G
ORIGINATING DOCUMENTS: IE Bulletin 79-02

REVISE

REFERENCE DRAWINGS

DRAWING NO.	SHEET NO.	SUFFIX	REV.

REVISE

REFERENCE SPEC. PARAGRAPHS

PARAGRAPH	PAGE	REV.

NOTES

1. THIS PED REVISES DIRECTION PREVIOUSLY PROVIDED BY THE FOLLOWING PED(s): NA
2. THIS PED WORK SHOULD BE COORDINATED WITH KNOWN OTHER CONTRACTOR WORK UNDER THE FOLLOWING PED'S: NA
3. THIS PED DEPENDS ON THE PRIOR INSTALLATION OF THE FOLLOWING PED'S. NA

APPROVALS:

DISCIPLINE ENGINEER: [signature] DATE: 12/12/79

LEAD ENGINEER: [signature] DATE: 12/12/79

COG CONTRACT ENGR.: NA DATE:

S/U LIAISON ENGR.: [signature] DATE:

Exhibit B

Other Requirements

This PED is applicable to all Quality Classes of hangers. However, no retrofit is required unless specifically stated in the PED such as paragraph #2 & #3 (which is for Seismic Class I only).

The rework required by paragraph #2 & #3 shall be completed by February 1, 1980. Contractor shall supply a list of hangers reworked per paragraph #2 upon completion of work.

Contractor is reminded that leveling nuts may no longer be used, shims must be used instead per the attached procedure.

The procedure in this PED is intended to supplement the contractor's present procedures, and not to replace them. Therefore, various items may be subject to another installation and inspection procedure e.g. see paragraph 4.2.

C 68830

REF DOC.. PCN N/A			RFI N/A		WPPSS NUCLEAR PROJECT NO. 2
REF. SPEC. SECTION: N/A	PAGE:		PARA:		BURNS AND ROE, INC.
REF. DWG.: N/A			DWG. ZONE.		PED 215-CS-2075 SHT. 2 OF 1
SCALE: N/A	DRAWN BY [illegible]	DATE 12/12/79	REVIEWED [illegible]	DATE 12/14/79	TITLE: Floor Mou Base Plat
	CHKD BY V	DATE	APPVD [illegible]	DATE 12/24/79	Exhibit B

PROCEDURE FOR PLACING FLOOR MOUNTED SUPPORTS

1. General Notes

1.1 The base plate for floor mounted supports may be placed directly on the floor regardless of whether the drawing or detail shows a grout pad. However, the requirements of Section 4.0 shall be met.

1.2 Quality Class II hangers which are Seismic Class II and Quality Class G hangers which must be inspected, need not be inspected by QC, instead Engineering may evaluate them. All other hangers shall be inspected by QC. (See Evaluation Checklist, Figure #2).

2. Previously installed (& grouted) base plates and/or equipment pads utilizing leveling nuts (Applies to Seismic Class I)

2.1 Chip out all grout.

2.2 Back off leveling nut prior to removing threaded rod and nuts.

2.3 Install shims and level plate per Section 5.0 of this procedure.

2.4 Install new threaded rod, nut and lock washer.

2.5 Torque each anchor to the value shown in Table I.

2.6 Observe the location of the top of the anchor before and after torquing.

2.7 If anchor slips and moves to surface of concrete or above during torquing, anchor is deemed to have failed. QC shall make this check.

2.8 A failed anchor shall be replaced in accordance with Section 7.

2.9 If anchor does not move and sustains the torque it is acceptable.

2.10 After all anchors have been accepted, support shall be re-grouted in accordance with Contractor's approved grouting procedure.

C 68831

3.0 Previously installed, ungrouted, base plates and/or equipment pads utilizing leveling nuts (Applies to Seismic Class I hangers only)

3.1 Place shims as required to maintain plate level (See Section 5.0)

3.2 Back the leveling nut down untill there is at least a gap between the nut and the bottom of the plate.

3.3 Torque each anchor to the value shown in Table I.

3.4 Observe the location of the top of the anchor before and after torquing, make certain that a gap between leveling nut and plate is maintained during torquing.

3.5 If anchor slips and moves to surface of concrete or above during torquing, anchor is deemed to have failed. QC shall make this check.

3.6 A failed anchor shall be replaced in accordance with Section 7.

3.7 If anchor does not move and sustains the torque it is acceptable.

3.8 After all anchors have been accepted, support shall be grouted in accordance with contractor's approved grouting procedure.

4.0 Floor mounted base plates placed directly on the floor (No grout pad)

4.1 When desired floor mounted base plates may be placed directly on the floor in lieu of a grout pad provided the following procedure is followed.

4.2 Concrete expansion anchors installed for this case shall be inspected per contractor normal installation/inspection procedure.

4.3 Prior to mounting plate directly on floor make certian that the pipe or equipment will be properly supported, i.e. make certain that everything will fit now that the baseplate is approximately 1 inch lower than it was before.

4.4 Place plate on floor and check for proper bearing per Paragraph 4.7. Grout if required per Section 6. Concrete anchors must be inspected or evaluated and accepted prior to grouting.

4.5 In order to obtain adequate bearing area, it is acceptable to remove any concrete surface irregularities by grinding. However, no grinding shall be permitted to exceed 1/4" maximum depth below the surface.

4.6 Clearly mark the As-Built indicating that the base plate is mounted directly on the floor.

4.7 Grouting is required if the plate has insufficient bearing as defined below:

1. Any gap that is equal to or exceeds 3/32" for a distance of more than 1/2 of any side of the plate (the gap does not necessarily have to be continuous). The 3/32" is to be measured 1" under the plate.
2. Any gap that is equal to or exceeds 3/32" at two adjacent sides (corner) which when added together is greater than 1/2 the plate length (minimum length).

5.0 Shimming Base Plates

5.1 Shims shall be placed adjacent to (within 3/16") each anchor bolt. For anchor bolts adjacent to the edge of the plate the shims may not be placed between the anchor and the edge of the plate. See Figure #3 for clarification.

5.2 Shim size shall be limited to a maximum area of 1" x 1" at required thickness.

5.3 Shim stock may be of non-traceable steel.

5.4 One shim is required for each anchor bolt.

6.0 Grouting of Hanger Base Plates

6.1 This section applies only to floor mounted base plates per Section 4.5 of this procedure.

6.2 Concrete surfaces to receive grout shall be free of dirt, oil, grease, loose material, and laitance.

6.2.1 A boundary or "dam" shall be formed around the base plate using Ebeco 636 grout and/or Sikadur Hi Mod Gel 390 mixed and placed strictly in accordance with the manufacturer's recommendations.

6.2.2 At least one (1) air hole shall be placed on each side to allow trapped air to escape.

6.2.3 The boundary or "dam" material shall remain in place for a minimum of twenty four (24) hours after grout has been placed.

6.2.4 Placing grout shall be "Masterflow 814 Cable Grout".

6.2.5 Storage and handling of the grout shall be per manufacturer's instructions.

6.3 Mixing

6.3.1 The grout shall be mixed thoroughly with an electric mixer per manufacturer's recommendations.

6.3.2 Only enough material shall be mixed to grout plates in an immediate area - in no case shall more than five (5) pounds of dry grout be mixed at a time.

6.3.3 Special precautions shall be taken when the temperature falls below 40° F or goes above 90° F. If below 40° F at the time of mixing and placing the temperature of the grout after placing shall be maintained at 40° F or above for 48 hours. If above 90° F at time of mixing and placing water or iced water shall be added to bring grout temperature down to 50° F to 55 F°.

6.3.4 Mixing and placing of grout shall be in one continuous operation once the mixing has started, the grout shall be properly mixed and placed as soon as possible.

6.3.5 When the mixed grout cannot be placed within 45 minutes, all such grout shall be removed from the work area immediately and disposed of.

6.4 Placement of Grout

6.4.1 Grout shall be placed in accordance with manufacturer's recommendations and as stated below.

6.4.2 Area to receive grout shall be kept moist prior to grout placement for the period recommended by the manufacturer.

6.4.3 Grout shall be placed by caulking gun or hydraulically from one side only.

6.4.4 Thin metal or plastic strips shall be inserted in the grouting area repeatedly to eliminate trapped air.

6.4.5 The exposed grout shall be kept moist by covering it with clean, wet rags for a minimum of twenty four (24) hours.

7.0 Removing and Replacing Failed Anchors

7.1 If an anchor fails per the criteria of paragraph 2.8 or 3.6 it shall be removed by the following methods.

7.1.1 Remove plate and determine what type anchor it is.

7.1.2 Phillips Red Head Self Drilling anchor - remove it by inserting a threaded rod (the same size as the anchor) which will bear on the plug and pull on the shell. The threaded rod must either be machined on the end so that it can be inserted past the threaded portion of the anchor shell or steel plugs of appropriate length shall be inserted between rod and plug. By using a portion of pipe larger than the anchor diameter and a washer plate the anchor can be removed by turning the threaded rod and a nut attached to the rod, thus holding the plug in place and pulling the shell out. See Figure 1.

7.1.3 HDI's - Remove it by drilling out the plug with a drill bit slightly smaller than the anchor size. After the plug has been drilled out the shell may be removed as in paragraph 7.1.2 above or using a hydraulic jack.

7.1.4 Under no circumstance shall an anchor with the plug intact be removed by hydraulic jack.

7. 2 A failed anchor shall be replaced by one of the following methods. Replacement anchors shall be installed and inspected per normal installation procedures.

7.2.1 Phillips Red Head Self Drilling Anchor - The hole must be reamed to the next larger size for an HDI. For example, a 5/8" Red Head hole should be reamed to 1" diameter to allow insertion of a 3/4" HDI. For 3/4" & 7/8" Red Head anchors the only replacement allowed is 1" & 1 1/4" diameter Hilti Super Kwik Bolts.

7.2.2 HDIs - An HDI anchor of the same size or larger shall replace the removed anchor.

8.0 WALL AND CEILING MOUNTED SUPPORTS

8.1 Check bearing area in accordance with paragraph 4.7.

8.2 If adequate bearing area cannot be obtained by grinding (see paragraph 4.5) then support is to be grouted in accordance with Paragraph 6.0.

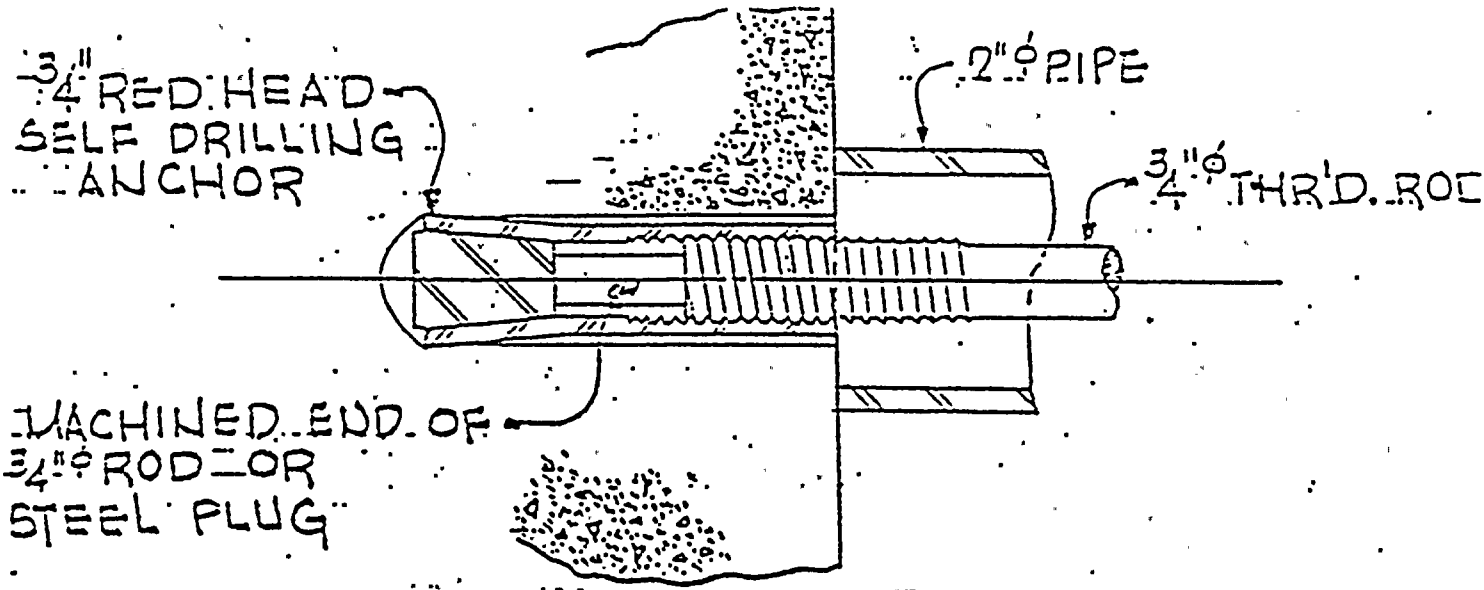
TABLE I
TORQUE TEST VALUES

Phillips Red Head		HDI	
Size	Test Torque (ft-lbs)	Size	Test Torque (ft-lbs)
		1/4"	8
		3/8"	25
1/2"	40	1/2"	40
5/8"	60	5/8"	65
3/4"	90	3/4"	140
7/8"	100		

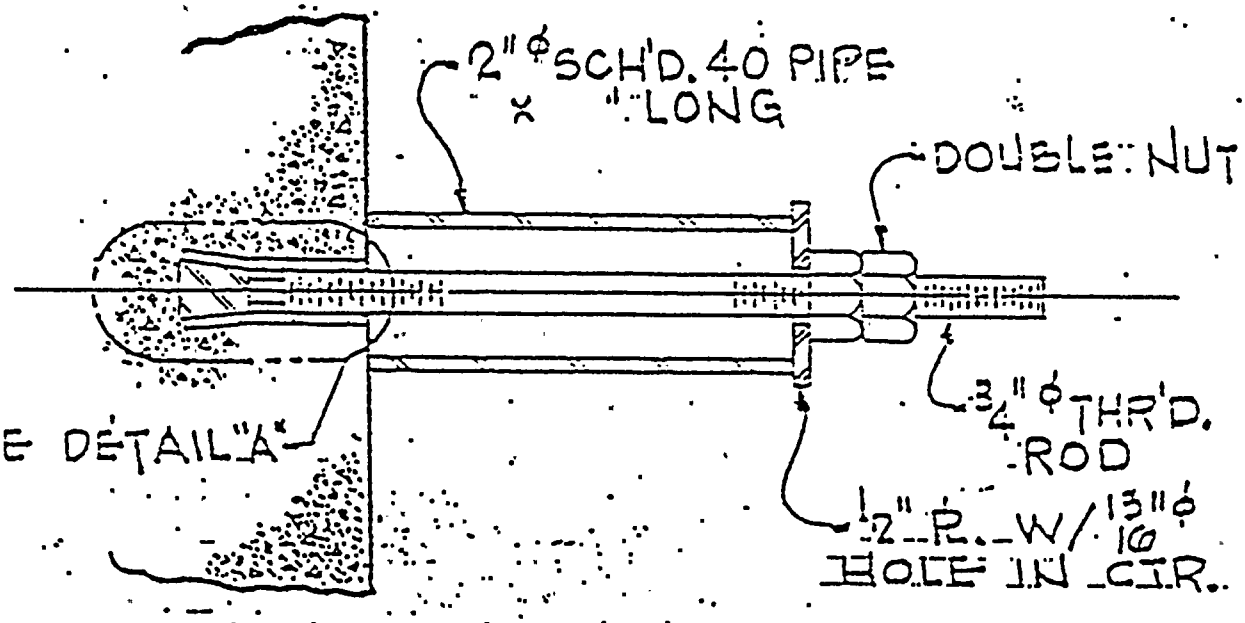
Note: The above torque values are different than the normal values used and are for use on this PED only.

C 68836

REF. DOC.. PCN N/A	RFI N/A	WPPSS NUCLEAR PROJECT NO.	
REF. SPEC. SECTION: N/A	PAGE: PARA:	BURNS AND ROE, INC.	
REF. DWG.: N/A	DWG. ZONE:	PED 21S-CS-2075	SHT - OF
SCALE:	DRAWN BY [illegible] DATE 12/14/7[illegible]	REVIEWED [illegible] DATE 12/12/7[illegible]	TITLE. Floor Mounted B[illegible] Exhibit B



DETAIL "A"



REMOVAL OF 3/4" RED HEAD SELF-DRILLING ANCHORS

NOTE: REMOVAL OF OTHER SIZE ANCHORS SHALL BE DONE IN SIMILAR MANNER.

FIGURE I

C 68837

REF DOC., PCN N/A	RFI N/A		WPPSS NUCLEAR PROJECT NO. 2
REF. SPEC. SECTION: N/A	PAGE:	PARA:	BURNS AND ROE, INC.
REF. DWG.: N/A	DWG. ZONE:	PED 215-CS-2075	SHT. ~ OF. ~
SCALE: N.T.S.	DRAWN BY [illegible] DATE 12/12/79	REVIEWED [illegible] DATE 12/14/79	TITLE: Floor M Exhibit B
	CHKD BY	APPRD [illegible] DATE 12/14/79	

EVALUATION CHECKLIST

HANGER MARK #_____

BUILDING & ELEVATION_____

1. Baseplate is leveled & shimmed properly _____
2. Anchor did not move during test torquing _____
3. Torque wrench is properly calibrated _____
4. Proper torque has been applied _____
5. A gap exists between leveling nut and plate _____
6. Baseplate has been properly grouted _____
7. Baseplate has proper bearing _____

Remarks_____

_____

Engineer_____ Date_____

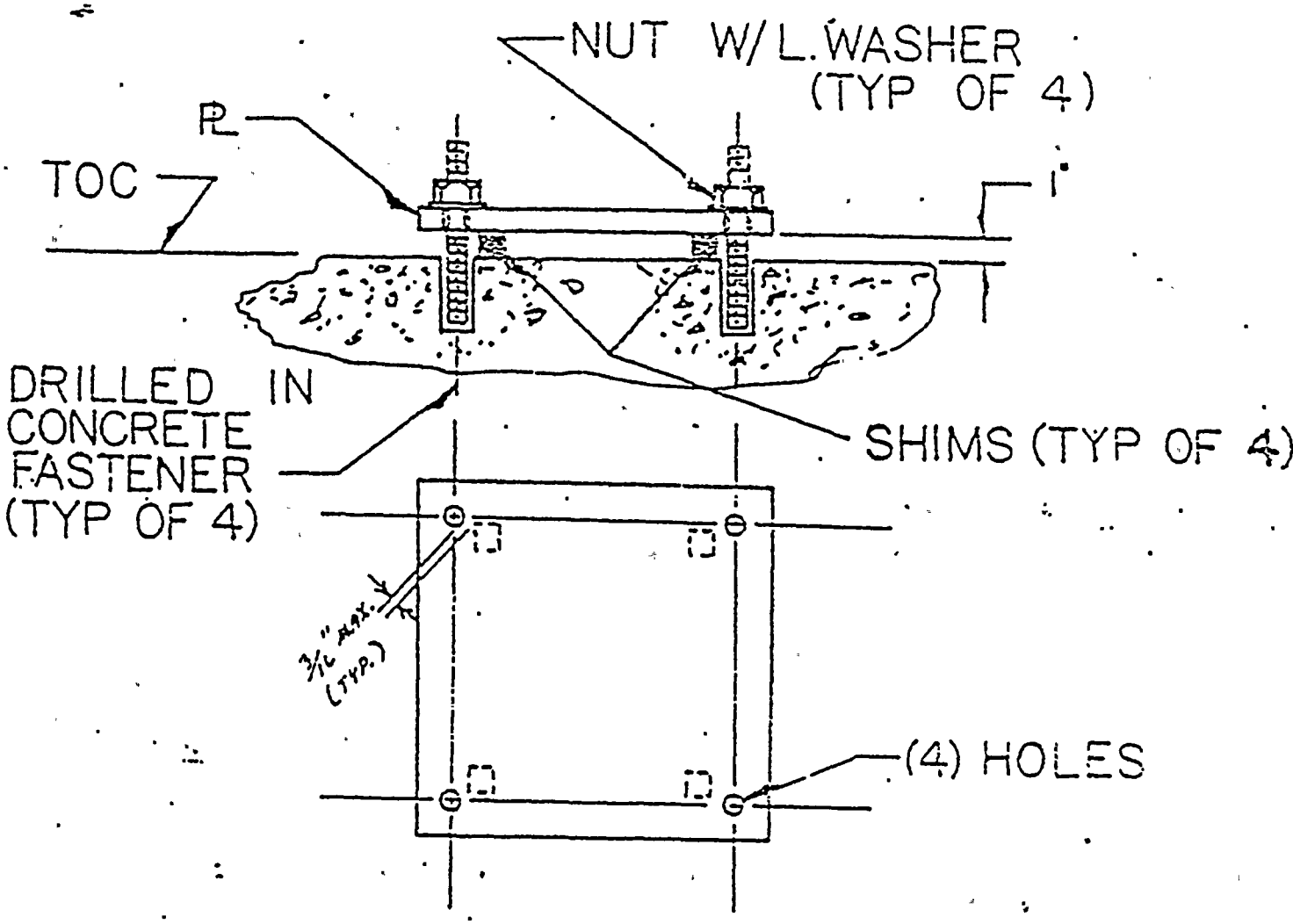
QC_____ Date_____

FIGURE #2

C 68838

REF DOC. PCN N/A	RFI N/A		WPPSS NUCLEAR PROJECT NO.
REF. SPEC. SECTION: N/A	PAGE:	PARA:	BURNS AND ROE, INC.
REF DWG.: N/A	DWG. ZONE:	PED 215-CS-2075	SHT
SCALE:	DRAWN BY [illegible] DATE 12/12/79	REVIEWED [illegible] DATE 12/14/79	TITLE: Floor M

Exhibit B



Note: Shim shall be kept inside the bolt line except no more than 1/2 of the shim may extend over the bolt line.

FIGURE #3

C 66839

REF DOC. PCN N/A	RFI N/A		WPPSS NUCLEAR PROJECT NO. 2
REF. SPEC. SECTION: N/A	PAGE:	PARA:	BURNS AND ROE, INC.
REF. DWG.: N/A	DWG. ZONE:	PED 215-CS-2075	SHT 11 OF
SCALE: 1/4	DRAWN BY [illegible] DATE 12/12/79	REVIEWED: [illegible] DATE 12/12/79	TITLE: Floor Exhibit B

EXHIBIT C

NRC BULLETIN 79-02 INSPECTION REQUIREMENTS

This exhibit is referenced in paragraphs 4.4, 4.4.1, 4.4.3, 4.4.4, 4.4.5, and 9.3 of the response to the Bulletin.

The vehicle that is used at WNP-2 to provide engineering instructions to Contractors is a Project Engineering Directive (PED). Even though generic instructions are issued which affect several contractors each contractor receives a PED with a unique number.

This exhibit consists of the PED issued to Contract 220. However, the instructions are generic and were issued to all affected contractors by the following PEDs:

Contract 213A	213A-CS-0087
Contract 215	See Exhibit D
Contract 216	216-CS-0322
Contract 217	217-CS-0033
Contract 220	220-CS-0247

BURNS AND ROE, INC.
WPPSS
NUCLEAR PROJECT
NO. 2

PROJECT ENGINEERING DIRECTIVE

CODE: 21 | PROJECT ENGINEERING DIRECTIVE: 220-CS-0217

DATE: 07/17/79 | PRIORITY: 1

INFORMATION CONTRACTORS: NA | SHEET 1 OF 3

REASON FOR P.E.D.:

To clarify and upgrade in-process inspection requirements for installation of concrete expansion anchors as required by NRC Bulletin 79-02.

INFORMATION COPY

REFERENCES

SUBJECT: INSPECTION OF CONCRETE ANCHORS
LOCATION: —
ENG. SYSTEM: —
S/U SYSTEM: —
QUALITY CLASS: I, II + G
ORIGINATING DOCUMENTS:

DESCRIPTION OF WORK:

Revise the specification requirements as shown on sheet 3 of 3 as noted below.

Paragraph 3.17.2.9 Page 15E-34a. Revise inspection requirements per page 3 of 3 and delete pull test requirement.

Note: 1. This PED applies to all Seismic Class I work and only to future work for Seismic Class II & G. Contractor shall revise and resubmit installation and inspection procedures to Engineer.

2. Contractor shall report in writing to Engineer the results of checking one bolt per plate per the specification requirements for the first 100 plates checked. The report shall include the number of anchors found to be unacceptable and the date the procedure was implemented.

3. Contractor shall provide in writing to the Engineer a list by Mark No. of all Seismic I hangers utilizing shell type anchors which have been installed prior to implementation of this procedure.

REVISE | REFERENCE DRAWINGS
DRAWING NO. – SHEET NO. – SUFFIX – REV.

REVISE | REFERENCE SPEC. PARAGRAPHS

REVISE	PARAGRAPH	PAGE	REV.
Y	3.17.2.09	15-34a	1

NOTES

1. THIS PED REVISES DIRECTION PREVIOUSLY PROVIDED BY THE FOLLOWING PED(s): 220-CS-0195 220-CS-0220
2. THIS PED WORK SHOULD BE COORDINATED WITH KNOWN OTHER CONTRACTOR WORK UNDER THE FOLLOWING PED'S: N/A
3. THIS PED DEPENDS ON THE PRIOR INSTALLATION OF THE FOLLOWING PED'S: N/A

APPROVALS:

DISCIPLINE ENGINEER — DATE 7/17/79
LEAD ENGINEER — DATE 7/18/79
COG. CONTRACT ENGR. — DATE 7-19-79
S/U LIAISON ENGR. — DATE 7/20/79
RESIDENT PROJ. ENGR.

Exhibit C

REFERENCE DRAWINGS

REVISE	DRAWING NO.	SHEET NO.	SUFFIX	REV.

REFERENCE SPEC. PARAGRAPHS

REVISE	PARAGRAPH	PAGE	REV.

This list shall also identify which hangers have been inspected in the retrofit program. For the purposes of developing this list (of installed Seismic Pipe Supports), a pipe support which has not yet been inspected to the retrofit requirements shall not be considered "installed".

4. The 20% inspection requirements for Quality Class II & G (non-siesmic I) are minimum and shall be increased if the rejection rate is unacceptable. Contractor's QA shall decide which 20% of the anchors shall be inspected and the acceptable rejection rate. An acceptable method of sampling and acceptable rejection rates are given below.

Note: Lot size shall be 100 anchors. (Lot means unit sample size)

Step:

1) Randomly select 20 anchors from a lot for inspection.
2) If the number of failed anchors is equal to or greater than 6, go to step 4.
3) If less than 6, continue on to the next lot and return to step 1.
4) Randomly select an additional 32 anchors from the same lot.
5) If the number of failed anchors is equal to or greater than 6, go to step 7.
6) If less than 6, continue on to the next lot and return to step 1.
7) Inspect all remaining anchors.
8) Inspect 100% of the next two lots (200 anchors). If in the second lot, the number of failures is equal to or less than 9, inspection may be reduced. Otherwise, continue 100% inspection untill this condition is reached.
9) Inspect 33% of the next lot of anchors if failure rate is equal to or less than 5, inspection may be reduced.
10) Return to step 1.

.8 If contractor elects to use a stud type insert (e.g. Hilti Kwik Bolt) as an approved equal it must have a length code stamped on the end in order to readily determine the amount of embedment after installation.

.9 In process inspection requirements for Class I and Class II installations:

a) Quality Class I (and Quality Class II & G which are SC-I)

All Quality Class I (and Quality Class II & G which are SC-I) installations shall have the installation of drilled-in concrete anchors verified and documented by QC. Such verification shall include as a minimum, a check of embedment, torque, proper size, and proper type for stud type anchors (e.g. Hilti Kwik Bolt) and the relative dimension, distance below top of concrete, torque, proper size and proper type for the shell type anchors (e.g.Hilti Drop-In).

Contractor shall remove a minimum of one (1) bolt per plate on all shell type anchors that have been successfully installed (and torqued). QC shall verify that the anchor has not pulled out against the plate. All anchors that are found to be pulled out against the plate shall be rejected and the remaining bolts for that plate shall be removed and similarly checked. In a similar manner, one bolt per plate, whether stud type or shell type shall also be checked for proper thread engagement, plate bolt hole size, bolt spacing and edge distance (concrete edge). If an anchor fails to meet the acceptance criteria for any of these items it shall be corrected and all other anchors on the plate shall be checked.

If inspected anchor is acceptable the bolt or nut shall be reinstalled and torqued.

b) Quality Class II & G

All Quality Class II & G drilled-in concrete anchors which are Seismic Class I shall have their installation verified and documented in accordance with the preceding paragraph.

In addition, 20% of the remaining Quality Class II & G drilled-in concrete anchors shall have their installation verified and documented by QC. Such verification shall include as a minimum, a check of embedment, torque, proper size, and proper type for stud anchors (e.g. Hilti Kwik Bolt) and the relative dimension, distance below top of concrete, torque, proper size and proper type for the shell type anchors (e.g. Hilti Drop-In).

REF DOC. PCN	RFI		WPPSS NUCLEAR PROJECT NO. 2
REF SPEC. SECTION: ---	PAGE: 15E-34a PARA: 3.17.2.9		BURNS AND ROE, INC.
REF DWG. —	DWG. ZONE N/A		PED 220-CS-0247 SHT 3 OF 3
SCALE N/A	DRAWN BY [illegible] DATE 7/17/79	REVIEWED [illegible] DATE 7/17/79	TITLE: INSPECTION - CONCRETE ANCH
	CHKD BY [illegible] DATE 7/17/79	APPVD [illegible] DATE 7/18	Exhibit C

EXHIBIT D

NRC BULLETIN 79-02 INSPECTION REQUIREMENTS FOR C215

This exhibit is referenced in paragraphs 4.4, and 4.4.2 of the response to the Bulletin.

UNITED ENGINEERS & CONSTRUCTORS
WPPSS
NUCLEAR PROJECT
NO. 2

PROJECT ENGINEERING DIRECTIVE

CODE: 2 1 | PROJECT ENGINEERING DIRECTIVE: 2 1 5 - C S - 1 0 1 1 9

DATE: 0 7 / 0 3 / 7 9 | PRIORITY: I

INFORMATION CONTRACTORS

SHEET 1 OF 4

REASON FOR P.E.D.:

To clarify and upgrade in-process inspection requirements for installation of concrete expansion anchors as required by NRC Bulletin 79-02.

INFORMATION COPY

REFERENCES

SUBJECT: Inspection of Concrete

LOCATION: Anchors

ENG. SYSTEM: —

S/U SYSTEM: —

QUALITY CLASS: I, II & G

ORIGINATING DOCUMENTS:

REVISE — REFERENCE DRAWINGS

DRAWING NO. – SHEET NO – SUFFIX – REV.

N/A

DESCRIPTION OF WORK:

Revise the specification requirements as shown on Sheets 3 of 4 and 4 of 4 and as noted below.

1. Paragraph 3.20.3.8 Page 15Q - 30a. Revise inspection requirements per page 3 of 4 and delete pull test requirement.

2. Page 15Q-49a Delete table 5-B.

Note: 1. This PED applies only to future work. Contractor shall revise and resubmit installation and inspection procedures to Engineer. It also applies to all small bore pipe supports. MLK

2. Contractor shall report in writing to Engineer the results of checking for anchors pulled against plates for the first 100 shell type anchors which are inspected and documented by QC. The report shall include the number of anchors found to be unacceptable and the date the procedure was implemented.

3. Contractor shall provide in writing to the Engineer a list by Mark. No. of all Seismic I hangers utilizing shell type anchors which have been installed prior to implementation of this procedure. This list shall also identify which hangers have been inspected in the retrofit program. Cont. Page 2

REVISE — REFERENCE SPEC. PARAGRAPHS

REVISE	PARAGRAPH	PAGE	REV.
Y	3.20.3.8	15Q-30a	
Y		15Q-49a	

NOTES

1. THIS PED REVISES DIRECTION PREVIOUSLY PROVIDED BY THE FOLLOWING PED(s): 215-CS-0923

2. THIS PED WORK SHOULD BE COORDINATED WITH KNOWN OTHER CONTRACTOR WORK UNDER THE FOLLOWING PED'S: C 63971

3. THIS PED DEPENDS ON THE PRIOR INSTALLATION OF THE FOLLOWING PED'S.

APPROVALS:

John O'Grady for MPK — DISCIPLINE ENGINEER — 7/3/79 DATE

Matthew Giannino — LEAD ENGINEER — 7-3-79 DATE

[signature] — CDR CONTRACT ENGR. — 7/3/79 DATE

[signature] — S/U LIAISON ENGR. — 7/5/79 DATE

[signature] — RESIDENT PROJ. ENGR.

Exhibit D

REVISE | REFERENCE DRAWINGS
DRAWING NO. – SHEET NO. – SUFFIX – REV.

REVISE | REFERENCE SPEC. PARAGRAPHS
PARAGRAPH | PAGE | REV.

For the purposes of developing this list (of installed Seismic Pipe Supports), a pipe support which has not yet been inspected to the retrofit requirements shall not be considered "installed".

4. The 20% inspection requirements for Quality Class II and G (non-seismic I) are minimum and shall be increased if the rejection rate is unacceptable. Contractor's QA shall decide which 20% of the anchors shall be inspected and the acceptable rejection rate. An acceptable method of sampling and acceptable rejection rates are given below.

Note: Lot size shall be 100 Anchors. (Lot means unit sample size)

Step:

1) Randomly select 20 anchors from a lot for inspection.

2) If the number of failed anchors is equal to or greater than 6, go to step 4.

3) If less than 6, continue on to the next lot and return to step 1.

4) Randomly select an additional 32 anchors from the same lot.

5) If the number of failed anchors is equal to or greater than 6, go to step 7.

6) If less than 6 Continue on to the next lot and return to step 1.

C 63975

7) Inspect all remaining anchors.

8) Inspect 100% of the next two lots (200 anchors). If in the second lot, the number of failures is equal to or less than 9, inspection may be reduced. Otherwise, continue 100% inspection untill this condition is reached.

9) Inspect 33% of the next lot of anchors if failure rate is equal to or less than 5, inspection may be reduced.

10) Return to Step 1.

.8 In Process Inspection

a) Quality Class I (and Quality Class II & G which are SC-I)

All Quality Class I (and Quality Class II & F which are SC-I) installations shall have the installation of drilled-in concrete anchors verified and documented by QC. Such verification shall include as a minimum, a check of the embedment, torque, proper size, and proper type for stud type anchors (e.g. Hilti Kwik Bolt) and the relative dimension, distance below top of concrete, torque, proper size and proper type for the shell type anchors (e.g. Hilti Drop-In).

Contractor shall remove a minimum of one (1) bolt per plate on all shell type anchors that have been successfully installed (and torqued). QC shall verify that the anchor has not pulled out against the plate. All anchors that are found to be pulled out against the plate shall be rejected and the remaining bolts for that plate shall be removed and similarly checked. The anchor shall also be checked for proper thread engagement, plate bolt hole size, bolt spacing and edge distance(concrete edge). If an anchor fails to meet the acceptance criteria for any of these items it shall be corrected and all other anchors on the plate shall be checked:

If inspected anchor is acceptable then the bolt shall be reinstalled and torqued.

b) Quality Class II & G

All Quality Class II & G drilled in concrete anchors which are Seismic Class I shall have their installation verified and documented in accordance with the preceding paragraph. In addition, 20% of the remaining Quality Class II & G drilled-in concrete anchors shall have their installation verified and documented by QC in accordance with the paragraph above.

3.20.4 Embedded Plates

3.20.4.1 Cast-in-Place Embedded Plates:

.1 The structural information drawings of Section 1C of the Specification show the location of embedded plates in some areas of the reactor building which are intended for the use of installation contractors for hangers and seismic restraints. The drawings show design locations for embedded plates and the installation tolerance for these plates is ±3". Prior to fabrication, and after approval, Contractor shall ascertain the exact location of all embedded plates to be used by him. Contractor shall submit calculations for each installation verifying that the worst condition of loading specified hereafter, has been checked and designed for. The calculation shall list the loads on each embedded plat

C 63976

REF DOC PCN	RFI		WPPSS NUCLEAR PROJECT NO. 2
REF SPEC SECTION 15Q	PAGE 15Q-30A	PARA: 3.20.3.8a	BURNS AND ROE, INC.
REF DWG.	DWG. ZONE:		PED 715-CS-1019 SHT. 3 OF 4
SCALE	DRAWN BY John O'Grady DATE 7/3/79	REVIEWED DATE	TITLE: INSPECTION OF CONCRETE ANCHOR
	CHKD BY JO Nolan DATE 7/3/79	APPVD DATE 7/3/79	

Exhibit D

TABLE 5

Insert Installation & Testing Information & Requirements

TABLE 5-A

Insert Size	Masonry Bit Diameter for Predrilling	Hole Depth	Relative Dimension Between Top of Insert and Top of Set Plug
3/8"	.572" - .577"	1-3/4"	0.800" - 0.925"
1/2"	.702" - .712"	2-1/4"	1.125" - 1.250"
5/8"	.863" - .873"	2-3/4"	1.375" - 1.562"
3/4"	1.020" -1.030"	3-1/2"	2.000" - 2.187"
7/8"	1.145" -1.155"	3-15/16"	2.312" - 2.500"

215 CMM e.j.

150-49a

C 6307

REF DOC PCN RFI WPPSS NUCLEAR PROJECT NO. 2

REF SPEC SECTION: 150. PAGE 150- 49a PARA:

REF DWG. DWG. ZONE. BURNS AND ROE, INC.

SCALE. DRAWN BY [illegible] DATE 7/3/79 REVIEWED DATE PED 215-CS-1019 SHT 4 OF 4

CHKD BY [illegible] DATE 7/3/79 APPVD. [illegible] DATE 7.3.79 TITLE: Inspection of Concrete

Exhibit D

EXHIBIT E

C215 RETROINSPECTION REQUIREMENTS

This exhibit is referenced in paragraphs 4.4. and 4.4.2 of the response to the Bulletin.

This exhibit consists of the original Contract 215 anchor retroinspection procedure dated April 1978 and Revision 6 of this procedure which included all of the Bulletin 79-02 inspection requirements, dated July 1979. This procedure was used for the retroinspection of all anchors installed by the Contractor prior to February 1978.

Revision 1 through 5 of the procedure did not change the inspection items given in Revision 0. Similiarly, Revision 7 through 9 of the procedure did not change the inspection items given in Revision 6.

BI PNS AND ROE, INC.
WPPSS
NUCLEAR PROJECT
NO. 2

PROJECT ENGINEERING DIRECTIVE

CODE	PROJECT ENGINEERING DIRECTIVE
2 1	2 1 5 - 1 6 5 - 1 0 5 0
DATE 0 7 / 1 3 / 7 9	PRIORITY I

INFORMATION CONTRACTORS _____ SHEET 1 OF 26

REASON FOR P.E.D.:

D To revise the Drilled-In Concrete Anchor Evaluation Procedure to include additional inspection requirements for installation of Drilled-In Anchors as required by the NRC.

REVISED BY PED INFORMATION COPY

DESCRIPTION OF WORK:

The additional inspection requirements are:

1) Check for edge distance.
(see section 6.1.4, page 7)

D 2) Check for base plate bolt hole diamgter.
(See Sections 6.2.1.1a, page 8
6.2.2.1b, page 10 and
7.2; page 13.

Note: Contractor shall supply the Engineer with a list of all Class I hangers inspected under the Retrofit program prior to incorpating this PED.

C 03738

REFERENCES

SUBJECT/INSPECTION OF DRILLED-IN ANCHORS
LOCATION N/A
ENG. SYSTEM N/A
S/U SYSTEM N/A
QUALITY CLASS I & II
ORIGINATING DOCUMENTS IE BULLETIN 79-02

REFERENCE DRAWINGS

DRAWING NO. – SHEET NO. – SUFFIX – REV.

REFERENCE SPEC. PARAGRAPHS

REVISE

PARAGRAPH	PAGE	REV.

NOTES

1. THIS PED REVISES DIRECTION PREVIOUSLY PROVIDED BY 215-CS-0957 THE FOLLOWING PED(s): _____
2. THIS PED WORK SHOULD BE COORDINATED WITH KNOWN OTHER CONTRACTOR WORK UNDER THE FOLLOWING PED'S: N/A
3. THIS PED DEPENDS ON THE PRIOR INSTALLATION OF THE FOLLOWING PED'S: N/A

APPROVALS:

John D Swoveny — DISCIPLINE ENGINEER — 7/17/79 DATE
Teresa Mulita — LEAD ENGINEER — 7.19.79 DATE
A L Becker — COG CONTRACT ENGR. — 7/26/79 DATE
L. B. Jones Jr — S/U LIAISON ENGR. — 7/30/79 DATE
J A Good — RESIDENT PROJ. ENGR. — 2/18/79 DATE

Exhibit E

DRILLED - IN CONCRETE ANCHOR EVAEUATION PROCEDURE

WPPSS NUCLEAR PROJECT NUMBER 2

RICHLAND WASHINGTON

REVISION 6.

Prepared By John D Sweeney 7/17/79

Submitted By Susan Aulsta 7/18/79

Resident Project Engineer J Z Hood 7/30/79

Quality Assurance Manager [illegible] 7.25.79

C 63739

Exhibit E

DRILLED - IN CONCRETE ANCHOR EVALUATION PROCEDURE

TABLE OF CONTENTS

C 63740

1.0 PURPOSE

The purpose of the evaluation is to check the adequacy of Installation of Drilled-In Concrete Anchors used in conjunction with pipe supports. A preliminary evaluation of pipe supports indicates a significant percentage of Drilled-In Anchors were not installed properly(improper epoxy used, anchor not fully expanded, etc.).

The purpose of this procedure is to provide specific instructions for evaluation acceptance, and any rework required of Drilled-In Concrete Anchors installed on pipe supports prior to February 1, 1978.

2.0 SCOPE

All Drilled-In Concrete Anchors on pipe supports installed prior to February 1, 1978 shall be evaluated.

The evaluation governed by this document shall be limited to a check for adequate concrete anchor installation and will not include a general inspection of the pipe support.

C 63741

3.0 DEFINITIONS AND ABBREVIATIONS

The Engineer - Burns and Roe Engineering.

Quality Control - The Contractor's Quality Control Department.

Quality Assurance - Burns and Roe Quality Assurance.

PRH - Phillips Red Head Self-Drilling (Snap-Off) Anchor.

HKB - Hilti Kwik Bolt

Relative Dimension - For Phillips Red Heads - Dimension from top of set plug to top of test gauge. Note that the relative dimension described here is different from that specified for new installations.

Depth of Embedment - for Hilti Kwik Bolt - Indicates the length of anchor below concrete.

C 63742

4.0 RESPONSIBILITIES FOR EVALUATION (See Attachment IV)

4.1 EVALUATION TEAM

The Evaluation Team shall be made up of the following personnel; one representative of the Contractor's Engineering Department, one representative of the Contractor's Quality Control Department, and any Craftsmen necessary to provide labor. Representatives of the Engineer and the Burns and Roe Quality Assurance Department will be present on a part-time basis to monitor the evaluation process.

4.1.1 CONTRACTOR'S ENGINEERING REPRESENTATIVE

The Contractor's Engineering Representative shall direct the overall evaluation of the pipe support in accordance with this Evaluation Procedure. The evaluating engineer will utilize whatever tools necessary to perform engineering evaluation and will insure that the Checklist is properly filled out. At the conclusion of the evaluation he shall sign and date the Evaluation Report.

4.1.2 CONTRACTORS QUALITY CONTROL REPRESENTATIVE

The Contractor's Quality Control Representative shall be notified when an anchor has been determined to be acceptable. He shall take the final inspection measurements and record them on the Evaluation Checklist before any rework is done on the Hanger utilizing that anchor. At the conclusion of the inspection he shall sign and date the Checklist.

4.2 CONTRACTOR'S ENGINEERING DEPARTMENT

The Contractor's Engineering Department shall be responsible for coordinating the overall evaluation effort to ensure that it is carried out in an orderly and timely fashion. As Evaluation Reports prepared by the Engineer are received, the Contractor's Engineering Department shall assign the pipe support to an Evaluation team, ensure that the pipe support is ready for Evaluation (scaffolding for access in place, etc.), and ensure that the necessary craftsmen to provide labor for the actual Evaluation are available. After evaluation is complete, the Contractor's Engineering Department shall review the Evaluation Report for correctness. The Contractor's Engineering Department shall be responsible for providing As-Built drawings and initiating RFI's as required by this procedure prior to returning Evaluation Reports to the Engineer.

All Evaluation Reports completed in a given week shall be returned via letter to the Engineer by noon Tuesday of the following week.

4.3 THE ENGINEER

C 63743

For pipe supports requiring evaluation the Engineer shall prepare Evaluation Reports (see section 5.0, Evaluation Reports; for details) and transmit them to the Contractor by letter.

Exhibit

The Engineer shall be responsible for providing the Contractor with Generic Fixes (see section 7.2.1 and Attachment III for details) to be used when anchor installation is found to be inadequate and rework is required. If a generic fix is not applicable (see section 7.2.2), the Contractor's Engineering Representative shall perform any necessary redesign.

4.4 QUALIFICATION OF EVALUATION TEAM

All personnel (excluding crafts) responsible for any part of this evaluation shall attend training sessions conducted by the Engineer to assure each member of the Evaluation Team is fully cognizant of his duties and responsibilities. Only evaluation Team personnel whose names appear on a list approved by the Engineer shall be allowed to perform evaluation work.

C 63711

5.0 EVALUATION REPORTS

Each evaluation report will consist of a copy of the pipe support detail and an Evaluation Checklist (see Attachment I) for the Drilled-In Concrete Anchors in each plate. Items 1 through 8 on the checklist will have been filled out by the Engineer. These include the hanger number, building and elevation, hanger plate number, applicable generic fix numbers, anchor numbers, size of anchor, center to center spacing for the anchors and a sketch of the anchor configuration on the plate. The anchors will be numbered consecutively, starting in the upper left hand corner and numbered clockwise around the plate. For plates on the ceiling or floor, North will be considered as up.

6.0 EVALUATION

6.1 GENERAL HANGER EVALUATION

6.1.1 Compare hanger configuration to detail attached to Evaluation Report. Check critical dimensions circled on hanger detail. If the actual dimensions fall outside the tolerance listed on the detail, then hanger configuration does not conform to the detail. The tolerance for center to center spacing of Drilled-In Anchors shall be ±1/2" for all hangers. Circle the appropriate part of Item 9 on the Checklist.

If the hanger configuration does not conform to the detail, then refer to Section 6.1.2. If the Hanger configuration does conform to the detail, then proceed to Section 6.1.3.

6.1.2 If the hanger configuration does not conform to the hanger detail per the criteria specified above, calculations performed by the Engineer are no longer valid and a final evaluation of Drilled-In Anchor installation cannot be made (see Section 7.3).

Evaluation of the pipe support may continue following the criteria in the procedure with the following exceptions: In Section 6.2.1.1g, the relative dimension shall be measured and recorded but not compared to the maximum acceptable relative dimension listed under Item 15a. The comparison in Section 6.2.2.3 shall not be performed. At the conclusion of the evaluation, Item 19d on the checklist shall be marked, and an as-built drawing of the pipe support attached to the Evaluation Report before it is returned to the Engineer. Note, that no rework is to be performed on the pipe support until final evaluation of the Evaluation Report and as-built drawing by the Engineer.

6.1.3 Check anchor spacing from nearby embedded items to ensure that the following criteria for minimum allowable distance for a Drilled-In Anchor from an embedded item are met:

Embedded Plates: 3"+½ of the center to center bolt spacing. This spacing is to be from the edge of the embedded plate to the center of the Drilled-In Anchor.

1¼" Richmond Inserts: 6"+½ of the center to center bolt spacing. This spacing is to be from the center of the Richmond insert to the center of the Drilled-In Anchor.

C 63746

Exhibit E

embedded unistrut. 3½ ± ½ of the center to center bolt spacing. This spacing is to be from the center of the embedded unistrut to the center of the Drilled-In Anchor.

NOTE: Bolt spacing referred to is the spacing listed under Item 7 on the checklist.

If the criteria are violated, note this on Item 10 with an "S". If another hanger is attached to the embedded item, note the type of hanger (pipe, cable tray, duct, etc.) and hanger number if possible and mark up Item 8 showing the location of the embedded item relative to the anchors. If the embedded item is a unistrut or strip plate, only report hangers attached within 12 inches of the anchor being inspected.

If the criteria are not violated, simply check Item 10.

6.1.4 Check that the anchor meets the following criteria for minimum allowable distance for a Drilled-In Anchor from free edge of concrete:

NOMINAL DIAMETER	EDGE DISTANCE (in.)
1/2"	3 3/8
5/8"	4
3/4"	4 3/4
7/8"	5 3/8

If the criteria are violated, note this on Item 10 with an "S" and mark up Item 8 showing the location of the free edge of concrete relative to the anchors.

If the criteria are not violated, simply check Item 10.

6.2 EVALUATION OF DRILLED-IN CONCRETE ANCHORS

Using an acceptable type of marker[1], number the bolts on the plate exactly as they are numbered on the checklist, i.e. starting with No. 1 in the upper left hand corner and number clockwise around the plate (for plates in ceiling or floor, use North as "up").

6.2.1 EVALUATION OF PHILLIPS RED HEAD ANCHORS

6.2.1.1 Visual Evaluation of Anchor

6.2.1.1a This operation should be done one bolt at a time, unless it can be established that removal of more than one bolt will not cause hanger to move. If at any time during anchor evaluation the hanger assembly moves, so note under remarks.

C 65717

[1] Sharpie 3000 Felt Tip Marker as manufactured by Sanford, or approved equal.

If any or all bolts to be tested cannot be removed because of interferences, so note under remarks. Torque each bolt per Table I. Remove bolt from each anchor to be inspected. Fill in Item 11 using "PRH" for Phillips Red Head Anchor. Check that the anchor has not pulled out against plate. If the anchor has pulled out against the plate, mark Item 12 with an "X" and note in remarks.

Check the nominal bolt diameter. If the diameter is different from that listed in Item 6, circle the diameter listed in Item 6 and record the actual bolt diameter next to the circled diameter.

Check the base plate bolt hole diameter. The bolt hole diameter may be a maximum of one-eighth inch (1/8") larger than the installed bolt if an approved welded washer plate is not used. If the bolt hole diameter does not meet this criteria, note in remarks.

6.2.1.1b Check location of top of anchor with respect to concrete surface. If the top of the anchor is approximately 1/16" to 3/8" below the surface of concrete, simply check Item 12. If the top of the anchor is above or flush with the surface of the concrete, mark Item 12 with an "X".

6.2.1.1c After each bolt has been removed, visually examine anchor to see if it has been modified (i.e. cut short at top), if it is loose in the hole, stripped threads are apparent, etc. If any obvious irregularities exist, mark Item 13 with an "X" and report details in remarks. If no irregularities exist, simply check Item 13.
Note: If a star anchor has been used (as evident by the silver plug) it must be removed in accordance with Section 8.3.

6.2.1.1d Check the angle of the anchor with respect to the face of the plate by threading an 8" long (minimum) threaded steel rod of proper diameter into insert and measuring the smallest acute angle between the rod and the surface of the plate.

If this angle is greater than 85° simply check Item 14 on the checklist. If this angle is between 80° and 85° , a beveled washer must be used when reinstalling the bolt and Item 14 shall be marked with a "W". If this angle is less than 80° , mark Item 14 with an "X".

6.2.1.1e Check bolt removed for length and thread damage. Bolt must be long enough for a four (4) full thread engagement. If threads are damaged or bolt is short, replace with a new bolt.

C 63745

6.2.1.1f Examine shell interior to see if epoxy is present over top of the plug. If it is, it must be ground off or otherwise removed (so the metallic top of set plug is visible) to enable the relative dimension to be taken.

6.2.1.1g Check relative dimension from top of set plug to snap off line of anchor with test gauge (see Attachment II). Insert test gauge into anchor and obtain a four (4) full thread engagement. Insert a machinist's rule or other suitable measuring device into the central hole of the test gauge until it hits the top of the plug. Take the measurement to the top of the test gauge and record it under Item 15b on the checklist. Compare the actual relative dimension (15b) to the maximum acceptable relative dimension (15a). If the actual relative dimension exceeds the maximum acceptable, circle the actual dimension.

6.2.1.2 TORQUING OF ANCHOR

After visual evaluation is complete, replace bolt in anchor and apply torque per Table I.

TABLE I

Torque Requirements for Phillips Red Heads

Nominal Diameter	Torque
1/2"	30-35 ft-lbs.
5/8"	55-60 ft-lbs.
3/4"	75-80 ft-lbs.
7/8"	95-100 ft-lbs.

If these torques cannot be obtained within one turn after bolt is seated on the plate, mark Item 17 with an "X". If the torque is reached, simply check Item 17.

6.2.2 EVALUATION OF HILTI KWIK BOLTS

6.2.2.1 Visual Evaluation of Anchor

6.2.2.1a This operation should be done one stud at a time unless it can be established that removal of more than one nut will not cause the hanger to move. If at any time during anchor evaluation the hanger assembly moves, so note under remarks.

If any studs cannot be inspected because of interferences, so note under remarks.

6.2.2.1b Fill in Item 11 using "HKB" for Hilti Kwik Bolt. Check nominal anchor bolt diameter. If the diameter is different from that listed in Item 6, circle the diameter listed in Item 6 and record the actual bolt diameter next to the circled diameter.

Check the base plate bolt hole diameter. The bolt hole diameter may be a maximum of one-eighth (1/8") larger than the installed bolt if an approved welded washer plate is not used. If the bolt hole diameter does not meet this criteria, note in remarks.

6.2.2.1c Visually examine anchor stud to see if it has been modified, if it is loose in the hole, stripped threads are apparent, etc. Check stud length to insure it penetrates base plate far enough for one full nut engagement and that nut is not bottomed on threads (i.e. unthreaded section of stud must not be above surface of plate.) If these irregularities exist, mark 13 with an "X". If no obvious irregularities exist, simply check Item 13.

6.2.2.1d Check angle of anchor with respect to face of plate by threading a standard coupling onto the stud and measuring the smallest acute angle between the coupling and the surface of the plate. If this angle is greater than 85° , simply check Item 14 on the checklist. If this angle is between 80° and 85° , a beveled washer must be installed between the plate and nut and Item 14 should be marked with a "W". If this angle is less than 80° , mark Item 14 with an "X".

6.2.2.2 ULTRASONIC EXAMINATION FOR LENGTH

6.2.2.2a Equipment

The ultrasonic equipment used shall have a digital readout and a range from 0 to 12 inches. The Contractor shall submit manufacturer's literature and specifications (on the proposed equipment) to the Engineer for approval prior to performing ultrasonic testing.

6.2.2.2b Calibration

The U. T. equipment shall be calibrated to a standard length Hilti Kwik Bolt specimen prior to inspection of each hanger and more often if required.

6.2.2.2c Procedure

Each Hilti Kwik Bolt on the hanger shall be U.T.'d for length unless it has a standard length code stamped on the end. Prior to applying the transducer to the end of the bolt, ascertain that the bolt end is relatively smooth and perpendicular to the axis of the bolt. If needed, touch up with a file. Subtract the exposed length from the total length to get the embedded length and record the actual embedment under Item 16 of the Checklist.

C 63750

SHT. Exhibit E
PED 2.

6.2.2.3 MINIMUM ACCEPTABLE EMBEDMENT

Refer to Item 16 on the Evaluation Checklist. Compare the actual depth of embedment to the minimum acceptable embedment (Table II). If the actual embedment is less than the minimum acceptable embedment, then circle the actual embedment (Item 16).

TABLE II

Minimum Acceptable Embedment for Hilti Kwik Bolts

Nominal Diameter	Minimum Embedment
1/2"	2 1/2"
5/8"	3 1/2"
3/4"	4"

In certain cases, the Engineer has determined that a Kwik Bolt should not be used for a particular Anchor. An Asterisk will appear under Item 16a if use of a Kwik Bolt is not acceptable. If inspection shows that a Kwik Bolt has been used, circle the appropriate part of Item 16a.

6.2.2.4 TORQUING

After inspection is complete, apply a torque to the stud per Table III.

TABLE III

Torque Requirements for Hilti Kwik Bolts

Nominal Diameter	Torque
1/2"	45-55 ft-lbs.
5/8"	80-90 ft-lbs.
3/4"	125-175 ft-lbs.

If these torques cannot be obtained, try to reset the anchor by redriving it into the hole. If the torque values still cannto be obtained, mark Item 17 with an "X". If the torque value is reached, simply check Item 17.

Note: Only try to redrive the anchor once.

6.3 LOAD TESTING

6.3.1 Procedure

C 63751

The evaluation checklist when initially issued to the Contractor will indicate under Item 18 if a pull test is required and the applicable load. The concrete anchor shall be pull tested to this value and the amount of slip at that loading shall be recorded. If it exceeds 1/16",

used on Phillips Red-Head Anchors if Item 15b is unacceptable and torque requirements are met. If Pull Test is found to be acceptable and all other items on Evaluation Checklist are acceptable, then Item 19A of the Evaluation Status should be checked. The load shall be as indicated in Pull Test Procedure.

6.3.2 Equipment

The Owner will supply the initial test device. Contractor may also provide this equipment but it must meet the Engineer's approval. The pull test device will basically consist of a hydraulic ram with holder and pump gauge for determining hydraulic pressure and dial gauge indicator for determining the amount of slip.

6.3.3 Calibration

All gauges and hydraulic system must be calibrated every six months, or when repairs are necessary, or there is any reason to doubt the accuracy of the gauges.

C 63752

7.0 FINAL EVALUATION

7.1 Acceptable

If none of the items or dimensions in Item 15 (relative dimension) and Item 16 (HKB use and embedment depth) are circled, the hanger configuration conforms to the attached detail for the criteria specified in Section 6.1.1, and no X's appear under Items 12, 13, 14, 17, or 18, the anchor is acceptable and Item 19a of the evaluation status should be checked. If any of the dimensions in Item 15 are circled, acceptance of the anchor will be based on the results of a Pull Test. See section 6.3.1.

7.2 Not Acceptable

If any of the dimensions in Items 15 and 16 are circled or any X's appear under Items 12, 13, 14, 17, or 18b or the bolt hole diameter does not meet the criteria specified in Section 6.2.1.1a or 6.2.2.1b, then the hanger requires rework (unacceptable anchors must be replaced).

7.2.1 Generic Fix

If possible, a Generic Fix should be used to rework the hanger plate (see Item 4 on the Checklist and Attachment III for applicable Generic Fixes). The Generic Fixes are designed to be relatively simple modifications to the hanger plate that may be used during the evaluation and without having to obtain the Engineer's concurrence. If a Generic Fix is to be used, mark Item 19b on the Checklist and record the Generic Fix Number in the space provided.

7.2.2 Redesign

If a Generic Fix is not to be used (none listed in Item 4, interferences, etc.), the support plate must be redesigned and Item 19c on the checklist marked. At some time after the Evaluation Report is returned to the Engineer (with 19c marked), an as-built of the redesigned hanger shall be furnished to the Engineer.

7.3 FINAL EVALUATION PENDING

If the hanger configuration does not conform to the detail (per criteria outlined in Section 6.1.1), then a final evaluation cannot be made pending a review of the as-built drawing by the Engineer. In this case, Item 19d on the Checklist should be marked.

C 66753

8.0 REWORK

8.1 Conformance to Procedures and Specifications

All rework, whether replacement of an anchor, Generic Fix, or rework due to redesign shall be performed in accordance with the Contractor's approved procedures for field modification of hangers. All specification requirements shall be met unless the Engineer specifically waives these requirements by an RFI.

8.2 Inspection

Upon completion of rework, newly installed anchors shall be inspected as follows:

Replacement: If an anchor is replaced the new anchor shall be inspected to the latest approved revision of Work Procedure 65 & 85.

Generic Fix: If a Generic Fix is applied to a hanger, only newly installed anchors shall be inspected. These new anchors shall be inspected to the latest approved revision of Work Procedure 65& 85. Anchors previously inspected, and found acceptable per this procedure, shall not be reinspected.

8.3 Replacement of Anchors

8.3.1 Red Head Self-Drilling Anchors

A Red Head anchor or star anchor may be removed by use of a pulling device which holds the plug in place and pulls the shell out. The hole must then be reamed out to the next larger size before it can be replaced with a Hilti Drop In or Hilti Super Kwik Bolt.

8.3.2 Hilti Kwik Bolts

A Hilti Kwik Bolt may be removed by chucking the end of the stud in an electric drill and spinning it until the wedges wear sufficiently on the stud to allow it to be easily removed. The hole must then be reamed out to the next larger size before it can be replaced with a Hilti Drop In or Hilti Super Kwik Bolt.

C 63751

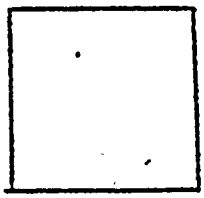
1) Hanger Number_____ Rev.____

2) Building/Elevation_____

3) Hanger Plate Number_____

4) Applicable Generic Fixes_____

8) Anchor Configuration



5) Anchor Number _____ _____ _____ _____ _____ _____ _____

6) Anchor Size (diameter) _____ _____ _____ _____ _____ _____ _____

7) Center to Center Spacing _____ _____ _____ _____ _____ _____ _____

9) Hanger Configuration Does/Does NOT conform to Hanger Detail

10) Spacing from Embedded Item _____ _____ _____ _____ _____ _____ _____

11) Type of Anchor _____ _____ _____ _____ _____ _____ _____

12) Depth Below Concrete _____ _____ _____ _____ _____ _____ _____

13) Anchor Modified _____ _____ _____ _____ _____ _____ _____

14) Angular Misalignment _____ _____ _____ _____ _____ _____ _____

15) Relative Dimension (PRH)

a) Maximum Acceptable _____ _____ _____ _____ _____ _____ _____

b) Actual _____ _____ _____ _____ _____ _____ _____

16) Embedment Depth (HKB) _____ _____ _____ _____ _____ _____ _____

a) HKB use acceptable _____ _____ _____ _____ _____ _____ _____

17) Torque Applied _____ _____ _____ _____ _____ _____ _____

18) Pull Test Required/Load _____ _____ _____ _____ _____ _____ _____

a) Amount of Slip _____ _____ _____ _____ _____ _____ _____

b) Reject _____ _____ _____ _____ _____ _____ _____

19) Evaluation Status

a) ☐ Anchor Installation Acceptable

b) ☐ Anchor Installation NOT Acceptable - Generic Fix #____

c) ☐ Anchor Installation NOT Acceptable - Redesign

d) ☐ Final Evaluation Pending

20) Remarks_____

_____

_____

_____

Engineer_____ Date_____ Quality Control C 63705 Date____

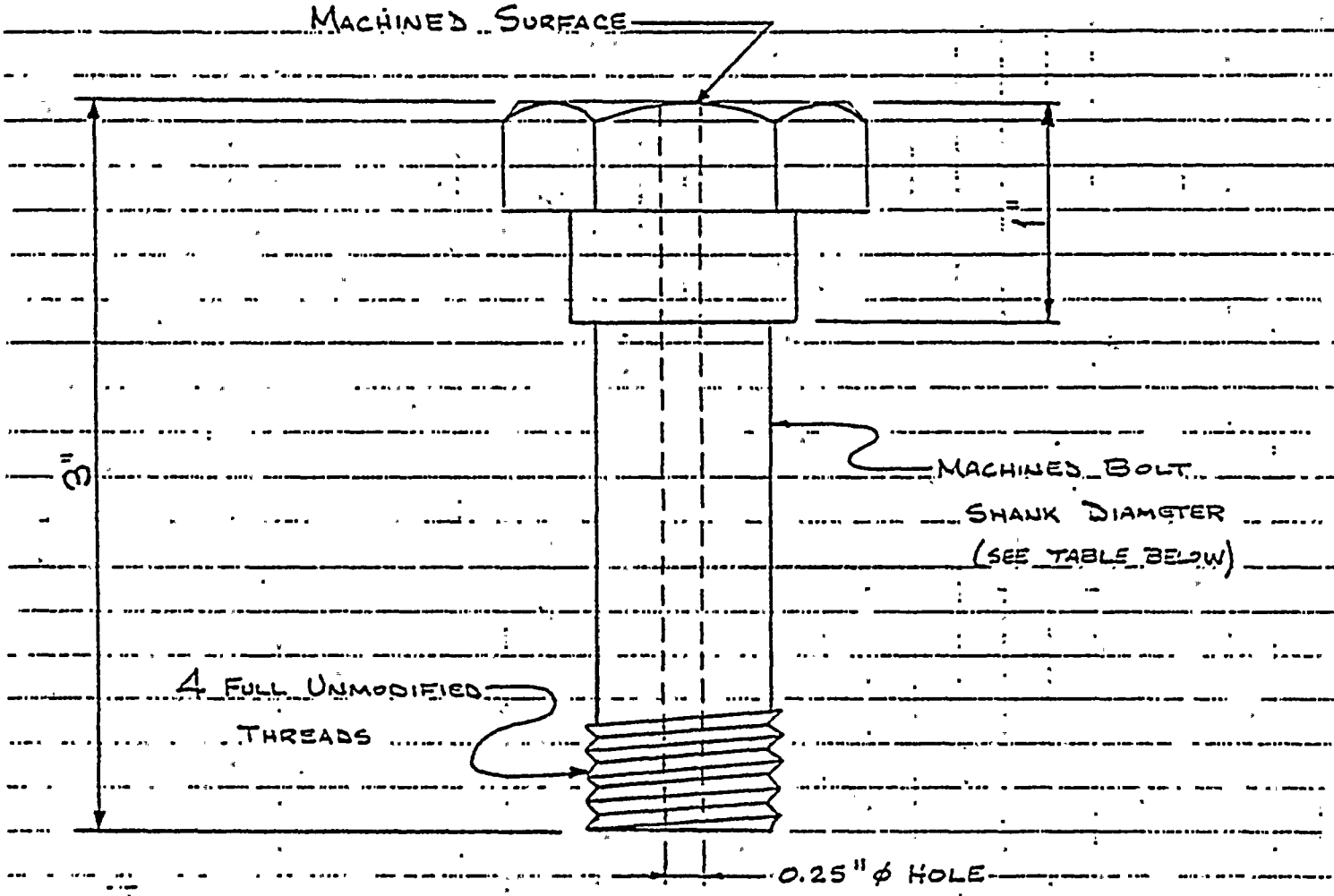
W.O. No. 3808 Date 12/1/78 Book No. _____ Page No. _____

Drawing No. _____ Calc. No. _____ Sheet 1 Cont. on Sheet _____

By John D'Swoney Checked _____ Approved _____

Title WPPSS - HANFORD No. 2 - TEST GAUGE FOR RELATIVE DIMENSION

TEST GAUGE FOR DRILLED-IN CONCRETE ANCHORS



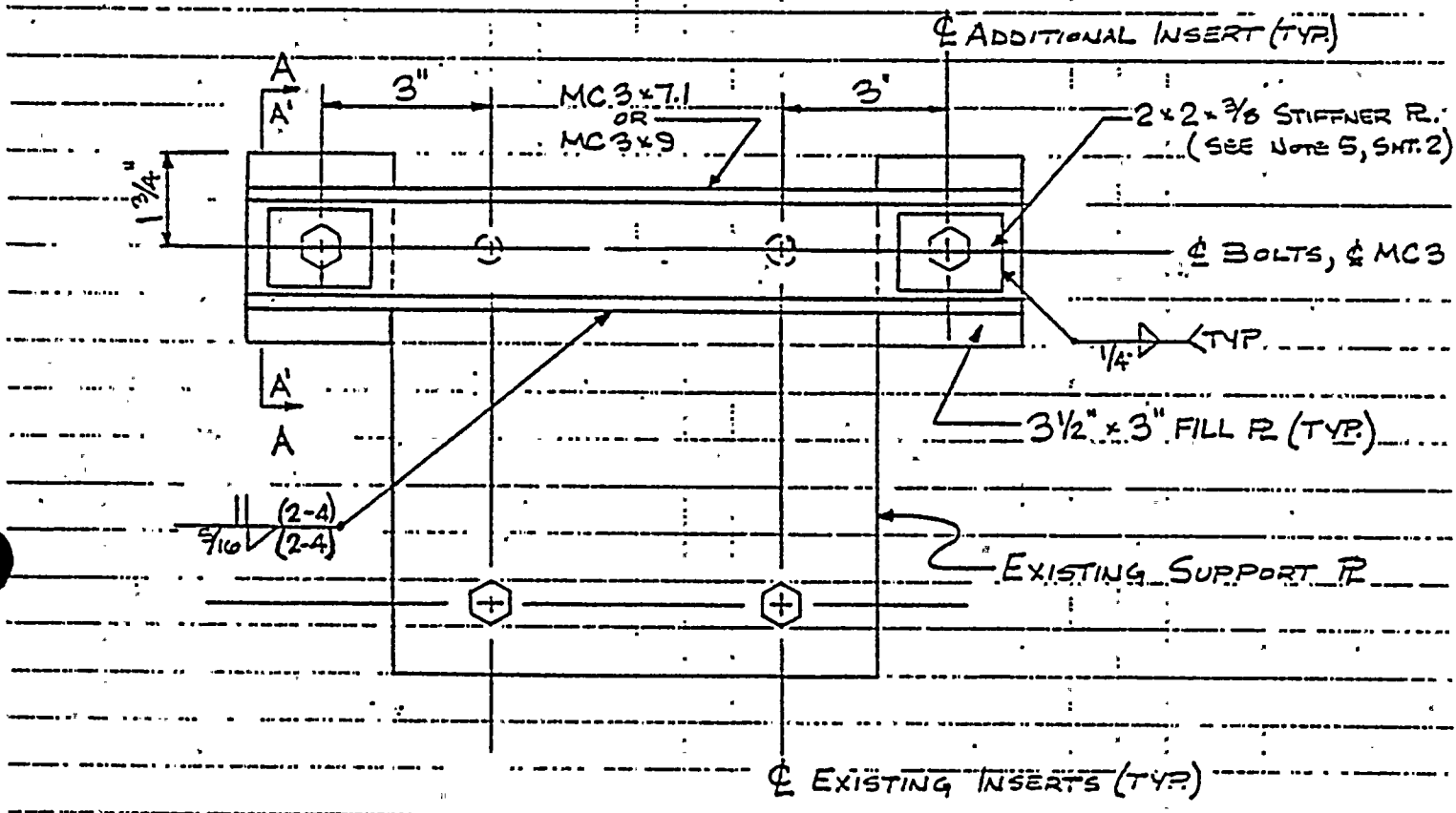
BOLT SIZE	THREADS/IN	MACHINED BOLT SHANK DIA.
1/2"	13	0.438"
5/8"	11	0.500"
3/4"	10	0.625"
7/8"	9	0.750"

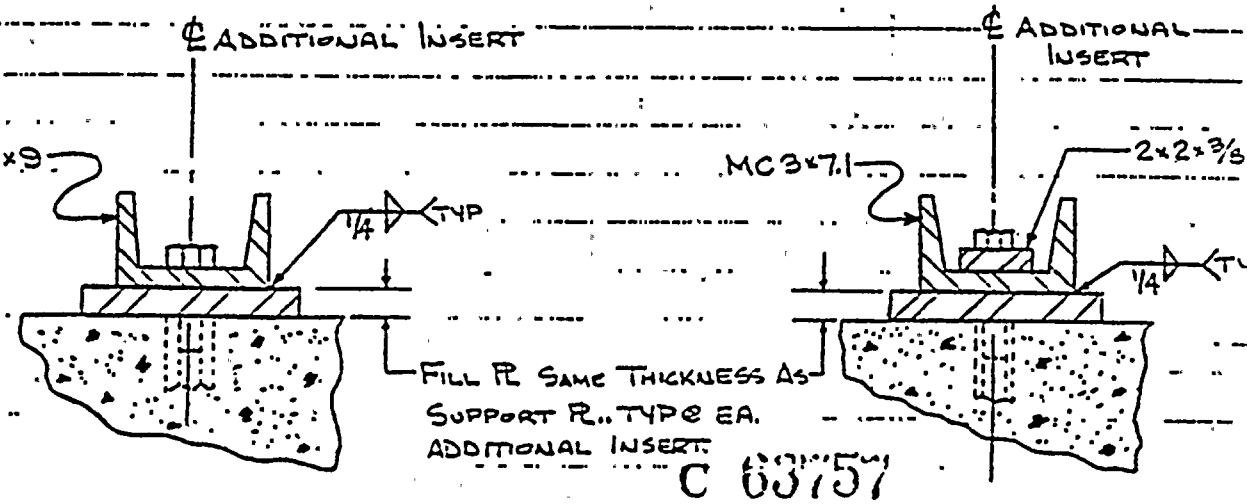
C 63756

W.O. No. 3000 Date 11.27.78 Book No. SXI Page No.
Drawing No. N/A Calc. No. 6.25.02 Sheet 1 Cont. on Sheet
By Checked 12/1/78 Approved 12/01/78
Title WPPSS - HANFORD No. 2 & PIPE SUPPORTS

GENERIC FIX FOR SUPPORT R. WITH IMPROPERLY INSTALLED DRILLED-IN INSERT

FIX NO. 1





C 63757

A-A

A' A'

FOR NOTES SEE SHT. 2

Form BR 8002-2 (5/78)

Exhibit E

BURNS AND ROE, INC.
New Jersey • New York • Connecticut • California

W.O. No. 3808 Date 3/27/78 Book No. SXT- Page No.
Drawing No. NA Calc. No. 6.25.02 Sheet 2 of
By MGH Checked LF 3/30/78 Approved ENJ 3/30/78
Title WPPSS ~ HANFORD No. 2 ~ PIPE SUPPORTS

GENERIC FIX FOR SUPPORT PL W/IMPROPERLY INSTALLED DRILLED-IN INSERT

NOTES: 1. USE AS SHOWN FOR REPLACEMENT OF 2 BOLTS ON A SIDE.

2. USE FOR ANY SIDE OF ANY SIZE PL PROVIDED NO MORE THAN 2 BOLTS NEED TO BE REPLACE ON THAT SIDE. PROVIDE HOLES IN MC 3x9 FOR BOLTING TO INSERTS NOT BEING REPLACED ON PLATES HAVING MORE THAN 4 BOLTS.

3. USE SAME SIZE ADDITIONAL INSERTS AS EXIS INSERTS.

4. MAY BE USED FOR REPLACING ALL 4 BOLTS ON A 4 BOLT PL

5. 2" x 2" x 3/8" STIFFNER PL IS REQUIRED ONLY WHEN MC 3x7.1 IS TO BE USED. SEE DETAIL A'-A'.

C 63758

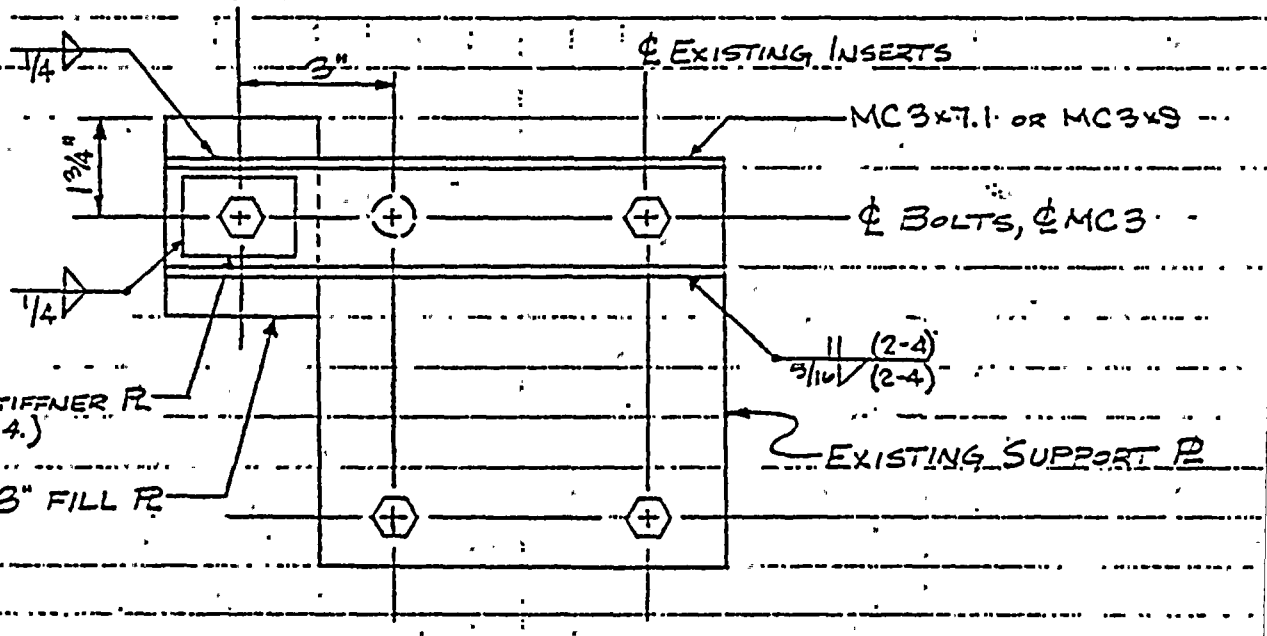
SHT. Exhibit E

BURNS AND ROE, INC.
Headquarters Office—Oradell, N.J.

W.O. No. 3805 Date 11-28-78 Book No. SK Page No.
Drawing No. N/A Calc. No. G.25.02 Sheet 3 Cont. on Sheet
By [illegible] Checked [illegible] 12/1/78 Approved [illegible] 12/21/78
Title WPPSS - HANFORD No. 2 - PIPE SUPPORTS

GENERIC FIX FOR SUPPORT R WITH IMPROPERLY INSTALLED DRILLED-IN INSERT.

FIX No. 2



NOTES:

① USE SAME SIZE ADDITIONAL INSERT AS EXISTING INSERT.

② CHECK THAT EXISTING INSERTS DO NOT BECOME OVERLOADED.

③ IF EXISTING INSERTS BECOME OVERLOADED USE FIX NO. 1.

④ 2"x2"x3/8" STIFFNER R IS REQUIRED ONLY WHEN MC3x7.1 IS TO BE USED.

C-63759

Form BR 8077-2 (5/78)

SH Exhibit E

W.O. No. 3808 Date 3/28/78 Book No. SXT Page No. PCD-215-C

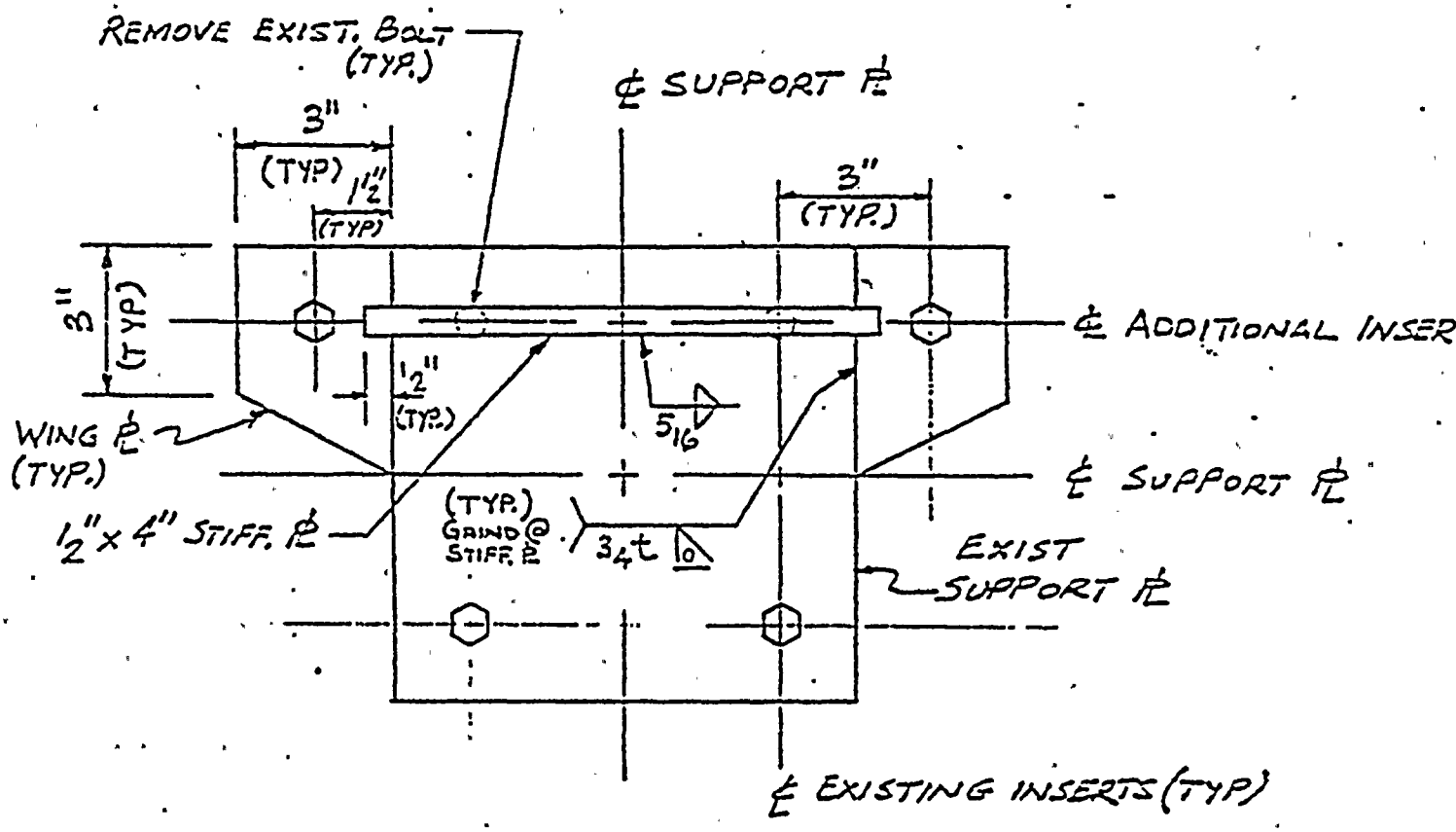
Drawing No. NA Calc. No. 6.25.02 (0) 1 Sheet 4 of

By: MHH Checked LE 3/30/78 Approved (TA) 4 3/78

Title WPPSS ~ HANFORD NO. 2 ~ PIPE SUPPORTS

GENERIC FIX FOR SUPPORT ℄ W/IMPROPERLY INSTALLED DRILLED-IN INSERTS

FIX NO. 3



NOTES: 1. t = SUPPORT ℄ THICKNESS = WING ℄ THICKNESS

2. USE AS SHOWN FOR REPLACEMENT OF 2 BOLTS ON ANY SIDE.

3. USE FOR FOUR BOLT ℄'S. DETAIL MAY BE USED ON BOTH SIDES OF ℄ TO REPLACE ALL FOUR BOLTS IF REQ'

C 65160

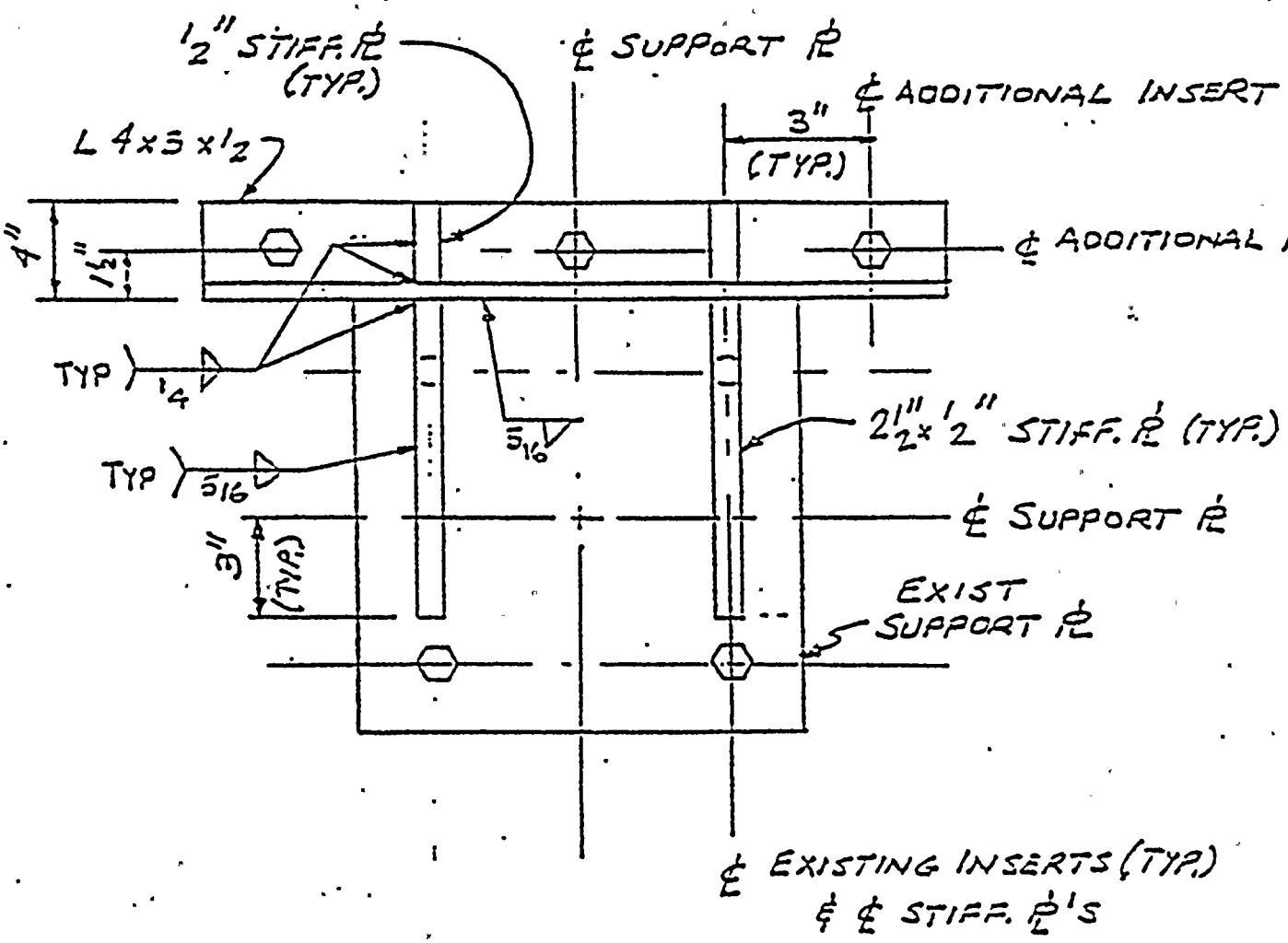
4. USE SAME SIZE ADDITIONAL INSERTS AS ℄

Exhibit

W.O. No. 3805 Date 3/27/78 Book No. SK Page No.
Drawing No. NA Calc. No. 6.25.02 NC 1 Sheet 2 of
By MHL Checked UE 3/30/78 Approved [illegible] 4/13/78
Title WPPSS – HANFORD NO. 2 – PIPE SUPPORTS

GENERIC FIX FOR SUPPORT ℄ W/IMPROPERLY INSTALLED DRILL
IN INSERT.

FIX NO. 4

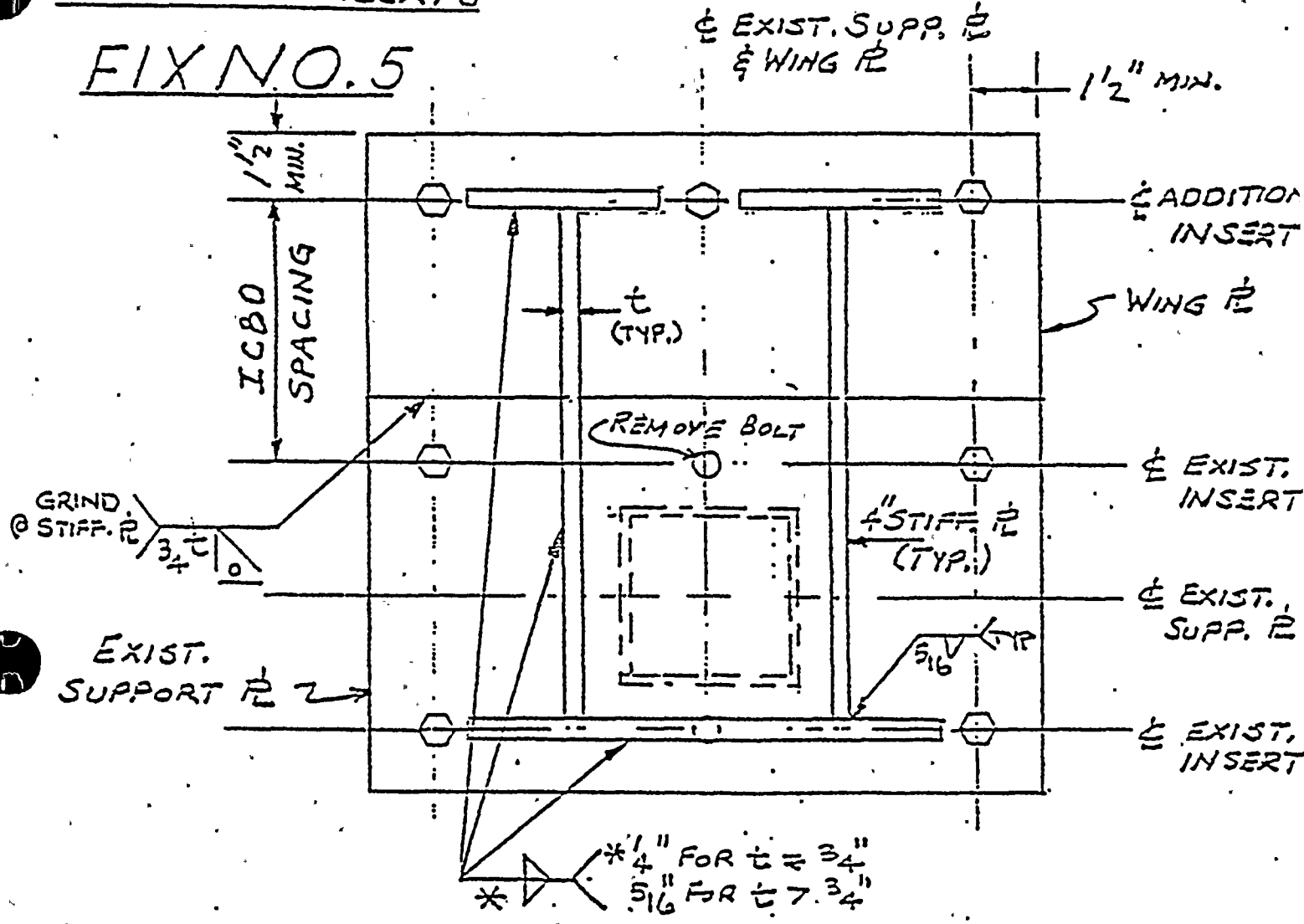


NOTES: 1. USE SAME SIZE ADDITIONAL INSERT AS EXISTING INSERT
2. CHECK THAT EXIST. INSERTS DO NOT BECOME OVERLOADED

C 63761

W.O. No. 3805 Date 3/20/78 Book No. SK- Page No.
Drawing No. NA Calc. No. G.75.02 Sheet 5 of
By MDH Checked LF 3/30/78 Approved
Title WPPSS ~ HANFORD No. 2 ~ PIPE SUPPORTS

GENERIC FIX FOR SUPPORT ℄ W/IMPROPERLY INSTALLED DRILLED-IN INSERTS



NOTE: 1. t = THICKNESS OF EXISTING SUPPORT ℄ & WING ℄

2. FIX MAY BE USED FOR 2 CENTER BOLTS ON 6 OR 8 BOLT ℄.
3. CHECK THAT EXIST. INSERTS DO NOT BECOME OVERLOADED.

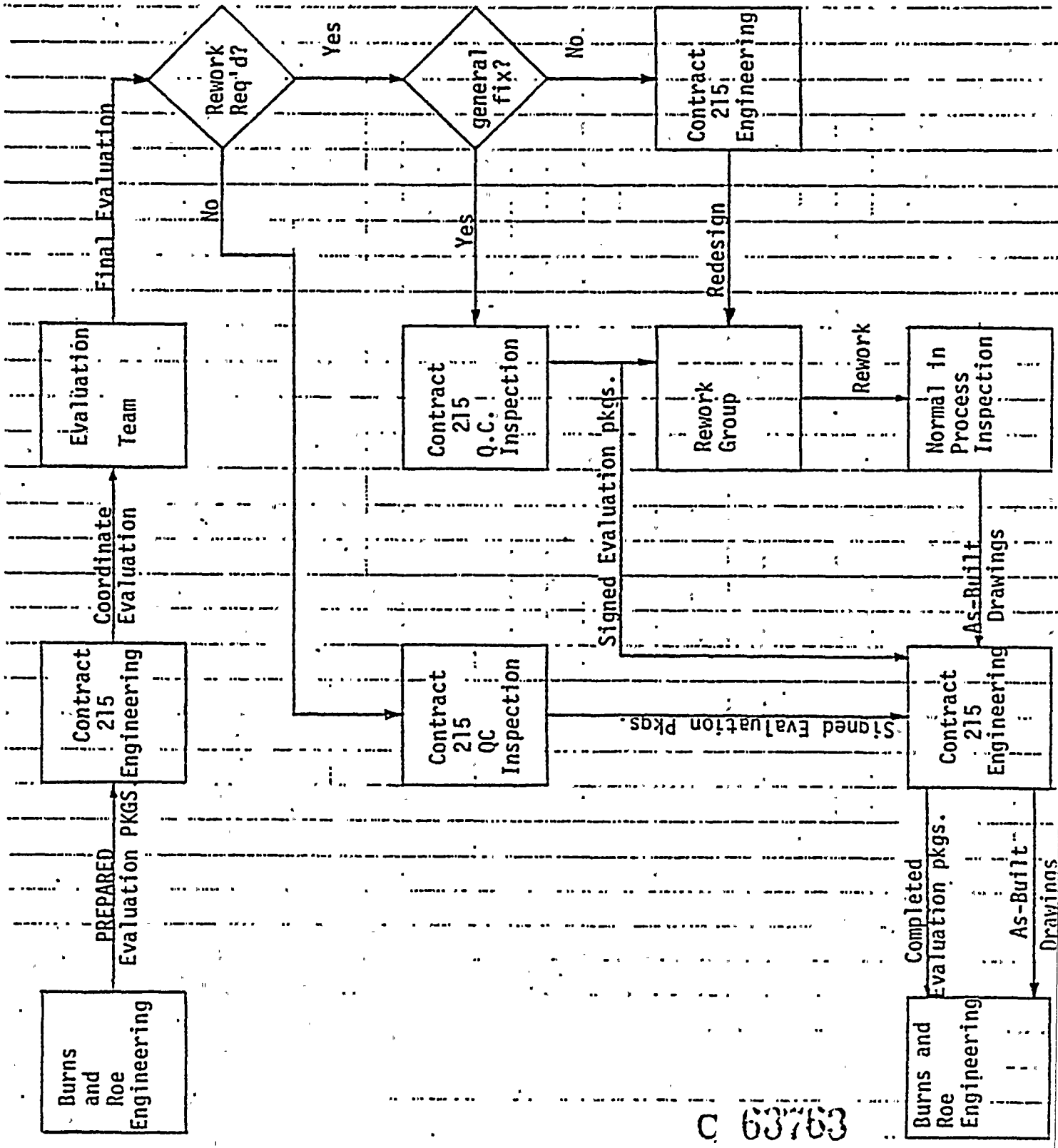
C 63752

W.O. No. _____ Date _____ Book No. _____ Page No. _____

Drawing No. _____ Calc. No. _____ Sheet _____ Cont. on Sheet _____

By _____ Checked _____ Approved _____

Title _____



C 63763

Form BR 8002-2 (5/78)

Exhibit E

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

MODIFICATION OF CONTRACT

1. CONTRACT MODIFICATION NO.

C.C. Designation DBD

PAGE 1 OF 1

2. EFFECTIVE DATE	3. CONTRACT NO.	4. UNIT NO(S).
	2808-215	WNP-2

5. ISSUED BY

Washington Public Power Supply System
3000 George Washington Way
P. O. Box 968
Richland, Washington 99352

6. ADMINISTERED BY (If other than block 5)

WNP-2 Project Management Group

7. CONTRACTOR NAME AND ADDRESS (Street, city, county, state, and ZIP Code)

WSH/Boecon/GERI
A Joint Venture
P. O. Box 1040
Richland, Washington 99352

8. REFERENCE DOCUMENTS

9A. CONTRACT PRICE ADJUSTMENT THIS CHANGE ONLY

☐ · INCREASE
☐ · DECREASE $ _____

9B. CONTRACT SCHEDULE ADJUSTMENT THIS CHANGE ONLY

☐ · ADD
☐ · DELETE DAYS -0-

10. CODE

(a) ☐ This unilateral Contract Modification is issued pursuant to _____
The modifications set forth in block 11 are made to the above numbered contract.

(b) ☐ The above numbered contract is modified to reflect the administrative changes set forth in block 11.

(c) ☒ This bilateral Contract Modification (Supplemental Agreement) is entered into pursuant to authority of _____
Section 1A Article 3.0 Changes in the Work modifies the above numbered contract as set forth in block 11.

11. DESCRIPTION OF MODIFICATION

The Contractor is to provide the following work in accordance with the terms and conditions of the Contract:

Incorporate the attached "Drilled-in Concrete Anchor Inspection Procedure" into the the procedures required under Contract 215 Specification 15Q, Article 3.21.2.

FOR INFORMATION ONLY

Except as provided herein, all terms and conditions of the contract, except as heretofore changed, remain unchanged and in full force and effect.

12. ☐ (a) CONTRACTOR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☒ (b) CONTRACTOR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN 3 COPIES TO ADMINISTRATIVE AND ISSUING OFFICES

13. NAME OF CONTRACTOR

By _____ (Signature of person authorized to sign)

14. NAME AND TITLE OF SIGNER (Type or print)

15. DATE SIGNED

16. WPPSS

By _____ (Authorized Representative)

17. NAME OF AUTHORIZED REPRESENTATIVE (Type or print)

18. DATE SIGNED

Exhibit E

DRILLED - IN CONCRETE ANCHOR INSPECTION PROCEDURE

WPPSS NUCLEAR PROJECT NUMBER 2

RICHLAND WASHINGTON

REVISION 0

Prepared By [illegible] 4/21/78

Submitted By Matthew Giannini 4.21.78

Resident Project Engineer [illegible] 4/21/78

Quality Assurance Manager C. J. Hutchins 4/21/78

Exhibit E

DRILLED - IN CONCRETE ANCHOR INSPECTION PROCEDURE

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of the inspection is to check the adequacy of Installation of Drilled-In Concrete Anchors used in conjunction with pipe supports. A preliminary inspection of pipe supports indicates a significant percentage of Drilled-In Anchors were not installed properly(improper epoxy used, anchor not fully expanded, etc.).

The purpose of this procedure is to provide specific instructions for inspection, acceptance, and any rework required of Drilled-In Concrete Anchors installed on pipe supports prior to February 1, 1978.

2.0 SCOPE

All Drilled-In Concrete Anchors on pipe supports with concrete anchor design loads exceeding 50% of allowables[1] shall be inspected.

The inspection governed by this document shall be limited to a check for adequate concrete anchor installation and will not include a general inspection of the pipe support.

---

[1]The Engineer shall determine which pipe supports meet this criteria.

3.0 DEFINITIONS AND ABBREVIATIONS

The Engineer - Burns and Roe Engineering.

Quality Control - The Contractor's Quality Control Department.

Quality Assurance - Burns and Roe Quality Assurance.

PRH - Phillips Red Head Self-Drilling (Snap-Off) Anchor.

HKB - Hilti Kwik Bolt

Relative Dimension - For Phillips Red Heads - Dimension from top of set plug to top of test gauge. Note that the relative dimension described here is different from that specified for new installations.

Depth of Embedment - for Hilti Kwik Bolt - Indicates the length of anchor below concrete.

4.0 RESPONSIBILITIES FOR INSPECTION (See Attachment IV)

4.1 INSPECTION TEAM

The Inspection Team shall be made up of the following personnel; one representative of the Contractor's Engineering Department; one representative of the Contractor's Quality Control Department, and any Craftsmen necessary to provide labor. Representatives of the Engineer and the Burns and Roe Quality Assurance Department will be present on a part-time basis to monitor the inspection.

4.1.1 CONTRACTOR'S ENGINEERING REPRESENTATIVE

The Contractor's Engineering Representative shall direct the overall inspection of the pipe support in accordance with this Inspection Procedure. He shall monitor the inspection of the pipe support and ensure the Inspection Checklist is properly filled out. At the conclusion of the inspection he shall sign and date the Inspection Report.

4.1.2 CONTRACTORS QUALITY CONTROL REPRESENTATIVE

The Contractor's Quality Control Representative shall take all required inspection measurements and fill out the Inspection Checklist. At the conclusion of the inspection he shall sign and date the Inspection Report.

4.2 CONTRACTOR'S ENGINEERING DEPARTMENT

The Contractor's Engineering Department shall be responsible for coordinating the overall inspection effort to ensure that it is carried out in an orderly and timely fashion. As Inspection Reports prepared by the Engineer are received, the Contractor's Engineering Department shall assign the pipe support to an inspection team, ensure that the pipe support is ready for inspection (scaffolding for access in place, etc.), and ensure that the necessary craftsmen to provide labor for the actual inspection are available. After inspection is complete, the Contractor's Engineering Department shall review the Inspection Report for correctness. The Contractor's Engineering Department shall be responsible for providing As-Built drawings and initiating RFI's as required by this procedure prior to returning Inspection Reports to the Engineer.

All Inspection Reports completed in a given week shall be returned via letter to the Engineer by noon Tuesday of the following week.

4.3 THE ENGINEER

The Engineer shall be responsible for determining by calculation which pipe supports require inspection. For pipe supports requiring inspection the Engineer shall prepare Inspection Repor

(see section 5.0, Inspection Reports, for details) and transmit them to the Contractor by letter on a system by system basis.

The Engineer shall be responsible for providing the Contractor with Generic Fixes (see section 7.2.1 and Attachment III for details) to be used when anchor installation is found to be inadequate and rework is required. If a generic fix is not applicable (see section 7.2.2), the Engineer shall perform any necessary redesign.

4.4 QUALIFICATION OF INSPECTION TEAM

All personnel (excluding crafts) responsible for any part of this inspection shall attend training sessions conducted by the Engineer to assure each member of the Inspection Team is fully cognizant of his duties and responsibilities. Only Inspection Team personnel whose names appear on a list approved by the Engineer shall be allowed to perform inspection work.

5.0 INSPECTION REPORTS

Each inspection report will consist of a copy of the pipe support detail and an Inspection Checklist (see Attachment I) for the Drilled-In Concrete Anchors in each plate. Items 1 through 8 on the checklist will have been filled out by the Engineer. These include the hanger number, building and elevation, hanger plate number, applicable generic fix numbers, anchor numbers, size of anchor, center to center spacing for the anchors and a sketch of the anchor configuration on the plate. The anchors will be numbered consecutively, starting in the upper left hand corner and numbered clockwise around the plate. For plates on the ceiling or floor, North will be considered as up.

6.0 INSPECTION

6.1 GENERAL HANGER INSPECTION

6.1.1 Compare hanger configuration to detail attached to Inspection Report. Check critical dimensions circled on hanger detail. If the actual dimensions fall outside the tolerance listed on the detail, then hanger configuration does not conform to the detail. The tolerance for center to center spacing of Drilled-In Anchors shall be ±1/2" for all hangers. Circle the appropriate part of Item 9 on the Checklist.

If the hanger configuration does not conform to the detail, then refer to Section 6.1.2. If the Hanger configuration does conform to the detail, then proceed to Section 6.1.3.

6.1.2 If the hanger configuration does not conform to the hanger detail per the criteria specified above, calculations performed by the Engineer are no longer valid and a final evaluation of Drilled-In Anchor installation cannot be made (see Section 7.3).

Inspection of the pipe support may continue following the criteria in the procedure with the following exceptions: In Section 6.2.1.1g, the relative dimension shall be measured and recorded but not compared to the maximum acceptable relative dimension listed under Item 15a. The comparison in Section 6.2.2.3 shall not be performed. At the conclusion of the inspection, Item 19d on the checklist shall be marked, and an as-built drawing of the pipe support attached to the Inspection Report before it is returned to the Engineer. Note, that no rework is to be performed on the pipe support until final evaluation of the Inspection Report and as-built drawing by the Engineer.

6.1.3 Check anchor spacing from nearby embedded items to ensure that the following criteria for minimum allowable distance for a Drilled-In Anchor from an embedded item are met:

Embedded Plates: 3"+½ of the center to center bolt spacing. This spacing is to be from the edge of the embedded plate to the center of the Drilled-In Anchor.

1½" Richmond Inserts: 6"+½ of the center to center bolt spacing. This spacing is to be from the center of the Richmond insert to the center of the Drilled-In Anchor.

Embedded Unistrut: 3½" + ½ of the center to center bolt spacing. This spacing is to be from the center of the embedded unistrut to the center of the Drilled-In Anchor.

NOTE: Bolt spacing referred to is the spacing listed under Item 7 on the checklist.

If the criteria are violated, note this on Item 10 with an "S". If another hanger is attached to the embedded item, note the type of hanger (pipe, cable tray, duct, etc.) and hanger number if possible and mark up Item 8 showing the location of the embedded item relative to the anchors. If the embedded item is a unistrut or strip plate, only report hangers attached within 12 inches of the anchor being inspected.

If the criteria are not violated, simply check Item 10.

6.2 INSPECTION OF DRILLED-IN CONCRETE ANCHORS

Using an acceptable type of marker[1], number the bolts on the plate exactly as they are numbered on the checklist, i.e. starting with No. 1 in the upper left hand corner and number clockwise around the plate (for plates in ceiling or floor, use North as "up").

6.2.1 INSPECTION OF PHILLIPS RED HEAD ANCHORS

6.2.1.1 Visual Inspection of Anchor

6.2.1.1a This operation should be done one bolt at a time, unless it can be established that removal of more than one bolt will not cause hanger to move. If at any time during anchor inspection the hanger assembly moves, so note under remarks.

If any or all bolts to be tested cannot be removed because of interferences, so note under remarks. Remove bolt from each anchor to be inspected. Fill in Item 11 using "PRH" for Phillips Red Head Anchors. Check the nominal bolt diameter. If the diameter is different from that listed in Item 6, circle the diameter listed in Item 6 and record the actual bolt diameter next to the circled diameter.

[1]Sharpie 3000 Felt Tip Marker as manufactured by Sanford, or approved equal.

6.2.1.1b Check location of top of anchor with respect to concrete surface. If the top of the anchor is flush or below surface of concrete, simply check Item 12. If the top of the anchor is above the surface of the concrete, mark Item 12 with an "X".

6.2.1.1c After each bolt has been removed, visually examine anchor to see if it has been modified (i.e. cut short at top), if it is loose in the hole, stripped threads are apparent, etc. If any obvious irregularities exist, mark Item 13 with an "X" and report details in remarks. If no irregularities exist, simply check Item 13.

6.2.1.1d Check the angle of the anchor with respect to the face of the plate by threading an 8" long (minimum) threaded steel rod of proper diameter into insert and measuring the smallest acute angle between the rod and the surface of the plate.

If this angle is greater than 85^{o}, simply check Item 14 on the checklist. If this angle is between 80^{o} and 85^{o}, a beveled washer must be used when reinstalling the bolt and Item 14 shall be marked with a "W". If this angle is less than 80^{o}, mark Item 14 with an "X".

6.2.1.1e Check bolt removed for length and thread damage. Bolt must be long enough for a four (4) full thread engagement. If threads are damaged or bolt is short, replace with a new bolt.

6.2.1.1f Examine shell interior to see if epoxy is present over top of the plug. If it is, it must be ground off or otherwise removed (so the metallic top of set plug is visible) to enable the relative dimension to be taken.

6.2.1.1g Check relative dimension from top of set plug to snap off line of anchor with test gauge (see Attachment II). Insert test gauge into anchor and obtain a four (4) full thread engagement. Insert a machinist's rule or other suitable measuring device into the central hole of the test gauge until it hits the top of the plug. Take the measurement to the top of the test gauge and record it under Item 15b on the checklist. Compare the actual relative dimension (15b) to the maximum acceptable relative dimension (15a). If the actual relative dimension exceeds the maximum acceptable, circle the actual dimension.

6.2.1.2 TORQUING OF ANCHOR

After visual inspection is complete, replace bolt in anchor and apply torque per Table I.

TABLE I

Torque Requirements for Phillips Red Heads

Nominal Diameter	Torque
1/2"	30-35 ft-lbs
5/8"	55-60 ft-lbs
3/4"	75-80 ft-lbs
7/8"	95-100 ft-lbs

If these torques cannot be obtained within one turn after bolt is seated on the plate, mark Item 17 with an "X". If the torque is reached, simply check Item 17.

6.2.2 INSPECTION OF HILTI KWIK BOLTS

6.2.2.1 Visual Inspection of Anchor

6.2.2.1a This operation should be done one stud at a time unless it can be established that removal of more than one nut will not cause the hanger to move. If at any time during anchor inspection the hanger assembly moves, so note under remarks.

If any studs cannot be inspected because of interferences, so note under remarks.

6.2.2.1b Fill in Item 11 using "HKB" for Hilti Kwik Bolt. Check nominal anchor bolt diameter. If the diameter is different from that listed in Item 6, circle the diameter listed in Item 6 and record the actual bolt diameter next to the circled diameter.

6.2.2.1c Visually examine anchor stud to see if it has been modified, if it is loose in the hole, stripped threads are apparent, etc. Check stud length to insure it penetrates base plate far enough for one full nut engagement and that nut is not bottomed out on threads (i.e. unthreaded section of stud must not be above surface of plate.) If these irregularities exist, mark 13 with an "X". If no obvious irregularities exist, simply check Item 13.

6.2.2.1d Check angle of anchor with respect to face of plate by threading a standard coupling onto the stud and measuring the smallest acut

angle between the coupling and the surface of the plate. If this angle is greater than 85°, simply check Item 14 on the checklist. If this angle is between 80° and 85°, a beveled washer must be installed between the plate and nut and Item 14 should be marked with a "W". If this angle is less than 80°, mark Item 14 with an "X".

6.2.2.2 ULTRASONIC EXAMINATION FOR LENGTH

6.2.2.2a Equipment

The ultrasonic equipment used shall have a digital readout and a range from 0 to 12 inches. The Contractor shall submit manufacturer's literature and specifications (on the proposed equipment) to the Engineer for approval prior to performing ultrasonic testing.

6.2.2.2b Calibration

The U.T. equipment shall be calibrated to a standard length Hilti Kwik Bolt specimen prior to inspection of each hanger and more often if required.

6.2.2.2c Procedure

Each Hilti Kwik Bolt on the hanger shall be U.T.'d for length unless it has a standard length code stamped on the end. Prior to applying the transducer to the end of the bolt, ascertain that the bolt end is relatively smooth and perpendicular to the axis of the bolt. If needed, touch up with a file. Subtract the exposed length from the total length to get the embedded length and record the actual embedment under Item 16 of the Checklist.

6.2.2.3 MINIMUM ACCEPTABLE EMBEDMENT

Refer to Item 16 on the Inspection Checklist. Compare the actual depth of embedment to the minimum acceptable embedment (Table II). If the actual embedment is less than the minimum acceptable embedment, then circle the actual embedment (Item 16).

TABLE II

Minimum Acceptable Embedment for Hilti Kwik Bolts

Nominal Diameter	Minimum Embedment
1/2"	3"
5/8"	3-½"
3/4"	4"

In certain cases, the Engineer has determined that a Kwik Bolt should not be used for a particular Anchor. An Asterisk will appear under Item 16a if use of a Kwik Bolt is not acceptable. If inspection shows that a Kwik Bolt has been used, circle the appropriate part of Item 16a.

6.2.2.4 TOROUING

After inspection is complete, apply a torque to the stud per Table III.

TABLE III

Torque Requirements for Hilti Kwik Bolts

Nominal Diameter	Torque
1/2"	45-55 ft-lbs
5/8"	80-90 ft-lbs
3/4"	125-175 ft-lbs

If these torques cannot be obtained, try to reset tne anchor by redriving it into the hole. If the torque values still cannot be obtained, mark Item 17 with an "X". If the torque value is reached, simply check Item 17.

NOTE: Only try to redrive the anchor once.

6.3 LOAD TESTING

6.3.1 Procedure

The inspection checklist when initially issued to the Contractor will indicate under Item 18 if a pull test is required and the applicable load. The concrete Anchor shall be pull tested to this value and the amount of slip at that loading shall be recorded. If it exceeds 1/16", mark Item 18 "reject" with an "X". No anchor be pull tested unless it has been otherwise found

acceptable.

6.3.2 Equipment

The Owner will supply the initial test device. Contractor may also provide this equipment but it must meet the Engineer's approval. The pull test device will basically consist of a hydraulic ram with holder and pump gauge for determining hydraulic pressure and dial gauge indicator for determining the amount of slip.

6.3.3 Calibration

All gauges and hydraulic system must be calibrated every six months, or when repairs are necessary, or there is any reason to doubt the accuracy of the gauges.

7.0 FINAL EVALUATION

7.1 Acceptable

If none of the items or dimensions in Item 15 (relative dimension) and Item 16 (HKB use and embedment depth) are circled, the hanger configuration conforms to the attached detail for the criteria specified in Section 6.1.1, and no X's appear under Items 12, 13, 14, 17, or 18, the anchor is acceptable and Item 19a of the inspection status should be checked.

7.2 Not Acceptable

If any of the dimensions in Items 15 and 16 are circled or if any X's appear under Items 12, 13, 14, 17, or 18, then the hanger requires rework (unacceptable anchors must be replaced).

7.2.1 Generic Fix

If possible, a Generic Fix should be used to rework the hanger plate (see Item 4 on the Checklist and Attachment III for applicable Generic Fixes). The Generic Fixes are designed to be relatively simple modifications to the hanger plate that may be used during the inspection and without having to obtain the Engineer's concurrence. If a Generic Fix is used, mark Item 19b on the Checklist and record the Generic Fix Number used in the space provided.

7.2.2 Redesign

If a Generic Fix is not used (none listed in Item 4, interferences etc.), the support plate must be redesigned and Item 19c on the checklist marked. At the same time the Inspection Report is returned to the Engineer (with 19c marked), an RFI shall be initiated by the Contractor requesting a redesign for the hanger plate in question. In order to coordinate the redesign, the RFI number shall appear on the Inspection Report and the Inspection Report number on the RFI.

The Engineer shall perform the redesign and return it to the Contractor via the RFI. The Contractor shall then rework the hanger as required to conform to the redesign.

7.3 FINAL EVALUATION PENDING

If the hanger configuration does not conform to the detail (per criteria outlined in SEction 6.1.1), then a final evaluation cannot be made pending a review of the as-built drawing by the Engineer. In this case, Item 19d on the Checklist should be marked

8.0 REWORK

8.1 Conformance to Procedures and Specifications

All rework, whether replacement of an anchor, Generic Fix, or rework due to redesign shall be performed in accordance with the Contractor's approved procedures for field modification of hangers. All specification requirements shall be met unless the Engineer specifically waives these requirements by an RFI.

8.2 Reinspection

Upon completion of rework, newly installed anchors shall be inspected as follows:

Replacement: If an anchor is replaced the new anchor shall be inspected to the latest approved revision of Work Procedure 65.

Generic Fix: If a Generic Fix is applied to a hanger, only newly installed anchors shall be inspected. These new anchors shall be inspected to the latest approved revision of Work Procedure 65. Anchors previously inspected, and found acceptable per this procedure, shall not be reinspected.

Redesign: A new inspection report will accompany pipe support redesigns when they are returned to the Contractor via RFI. All anchors on pipe supports that are redesigned shall be inspected as per this procedure.

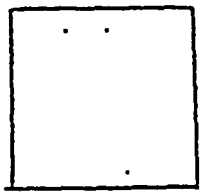
1) Hanger Number_____Rev.____

2) Building/Elevation_____

3) Hanger Plate Number_____

4) Applicable Generic Fixes_____

8) Anchor Configuration



5) Anchor Number								
6) Anchor Size (diameter)								
7) Center to Center Spacing								

9) Hanger Configuration Does/Does NOT conform to Hanger Detail

10) Spacing from Embedded Item								
11) Type of Anchor								
12) Depth Below Concrete								
13) Anchor Modified								
14) Angular Misalignment								
15) Relative Dimension (PRH)								
a) Maximum Acceptable								
b) Actual								
16) Embedment Depth (HKB)								
a) HKB use acceptable								
17) Torque Applied								
18) Pull Test Required/Load								
a) Amount of Slip								
b) Reject								

19) Final Evaluation

a) ☐ Anchor Installation Acceptable

b) ☐ Anchor Installation NOT Acceptable - Generic Fix #____

c) ☐ Anchor Installation NOT Acceptable - Redesign - RFI #____

d) ☐ Final Evaluation Pending

20) Remarks_____

Engineer_____Date_____ Quality Control_____Date_____

ATTACHMENT Exhibit E

New Jersey • New York • Connecticut • California

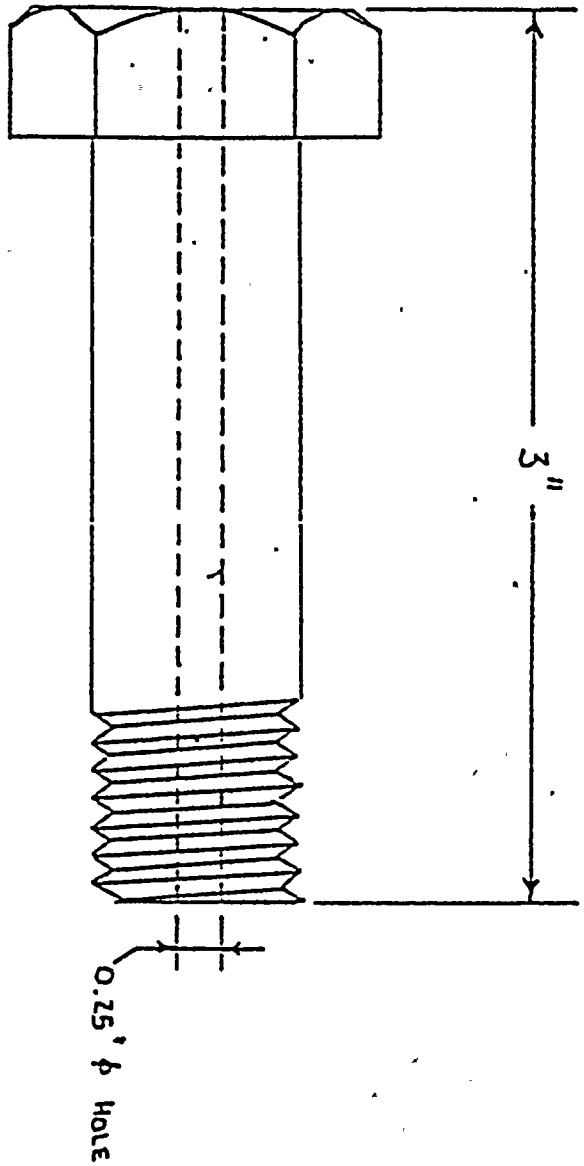
W.O. No. 3808-7C Date APRIL 17-1979 Book No. - Page No. -

Drawing No. - Calc. No: - Sheet 1 of 1

By W. M. MEAD Checked _____ Approved _____

Title WPPSS NUCLEAR PROJECT #2 - TEST GAUGE FOR RELATIVE DIMENSION

TEST GAUGE FOR DRILLED - IN CONCRETE ANCHORS



BOLT SIZE	THREADS/INCH
1/2" ϕ	13
5/8" ϕ	11
3/4" ϕ	10
7/8" ϕ	9

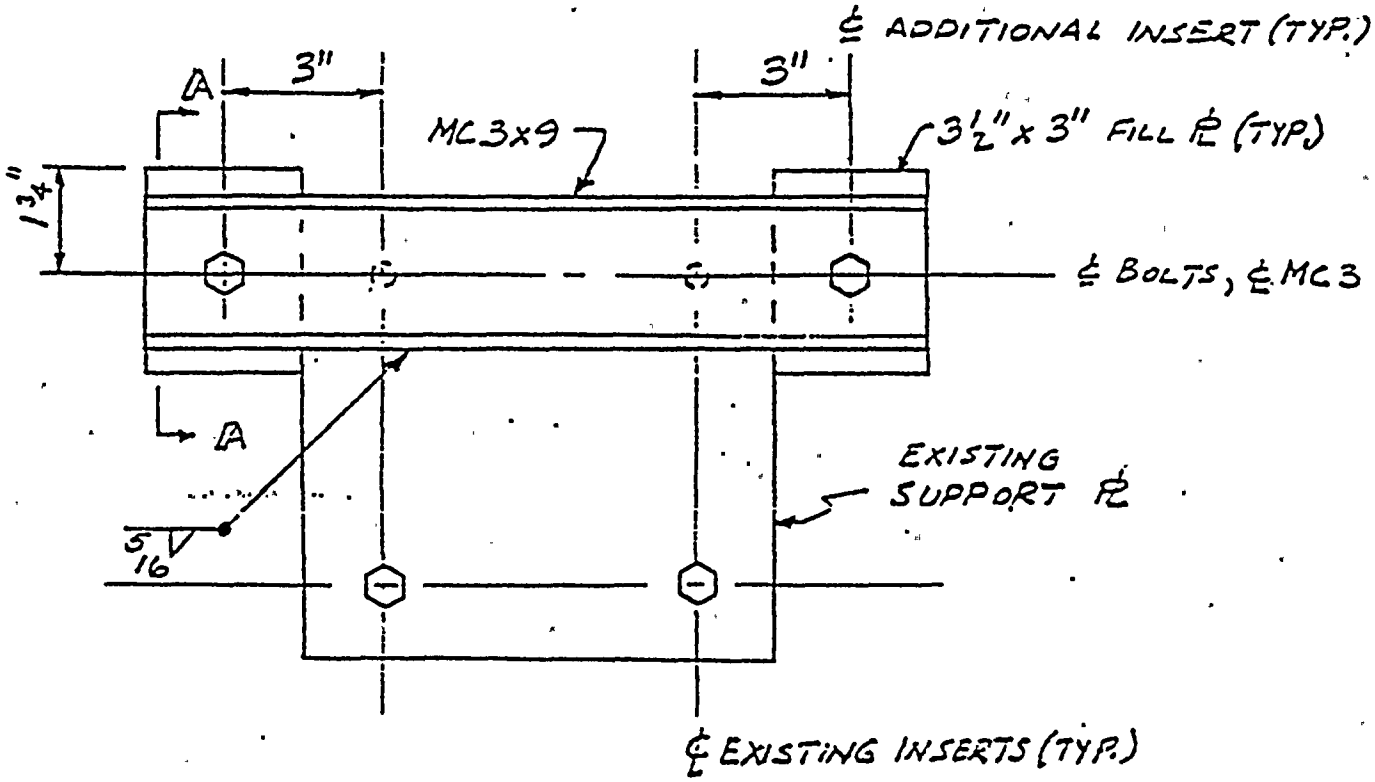
Exhibit E

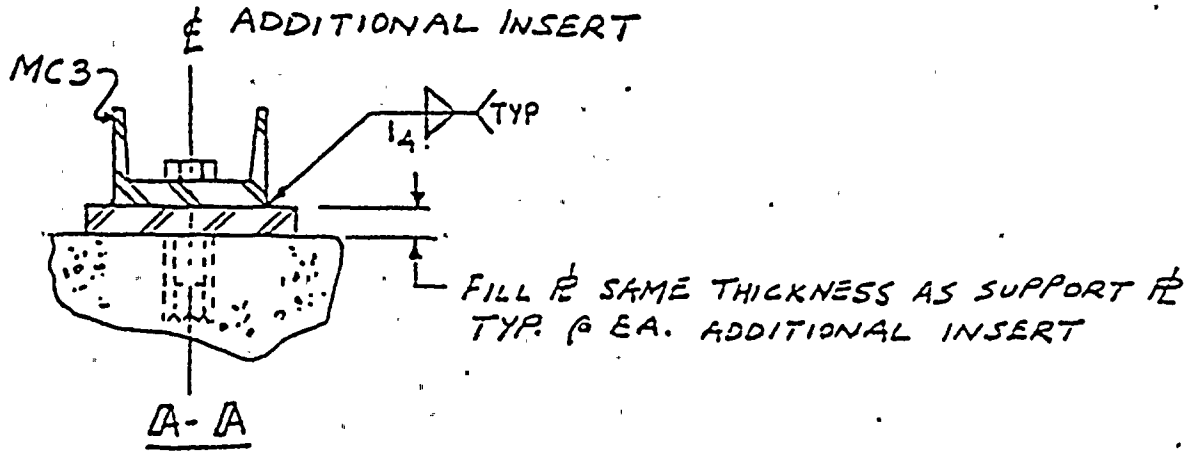
BURNS AND ROE, INC.
New Jersey • New York • Connecticut • California

W.O. No. 3808 Date 3/27/78 Book No. SK1 Page No.
Drawing No. NA Calc. No. 6.25.02 Sheet 1 of
By MGH Checked LF 3/30/78 Approved KNJ 6/3/78
Title WPPSS ~ HANFORD No. 2 ~ PIPE SUPPORTS

GENERIC FIX FOR SUPPORT ℄ W./IMPROPERLY INSTALLED DRILLED-IN INSERT.

FIX NO. 1





FOR NOTES SEE SHT. 2

BURNS AND ROE, INC.
New Jersey • New York • Connecticut • California

W.O. No. 3808 Date 3/27/78 Book No. SXI- Page No.
Drawing No. NA Calc. No. 6.25.02 Sheet 2 of
By MaH. Checked LF 3/30/78 Approved
Title WPPSS ~ HANFORD No. 2 ~ PIPE SUPPORTS

GENERIC FIX FOR SUPPORT PL W/IMPROPERLY INSTALLED DRILLED-IN INSERT

NOTES: 1. USE AS SHOWN FOR REPLACEMENT OF 2 BOLTS ON A SIDE.

2. USE FOR ANY SIDE OF ANY SIZE PL PROVIDED NO MORE THAN 2 BOLTS NEED TO BE REPLACED ON THAT SIDE. PROVIDE HOLES IN MC 3x9 FOR BOLTING TO INSERTS NOT BEING REPLACED ON PLATES HAVING MORE THAN 4 BOLTS.

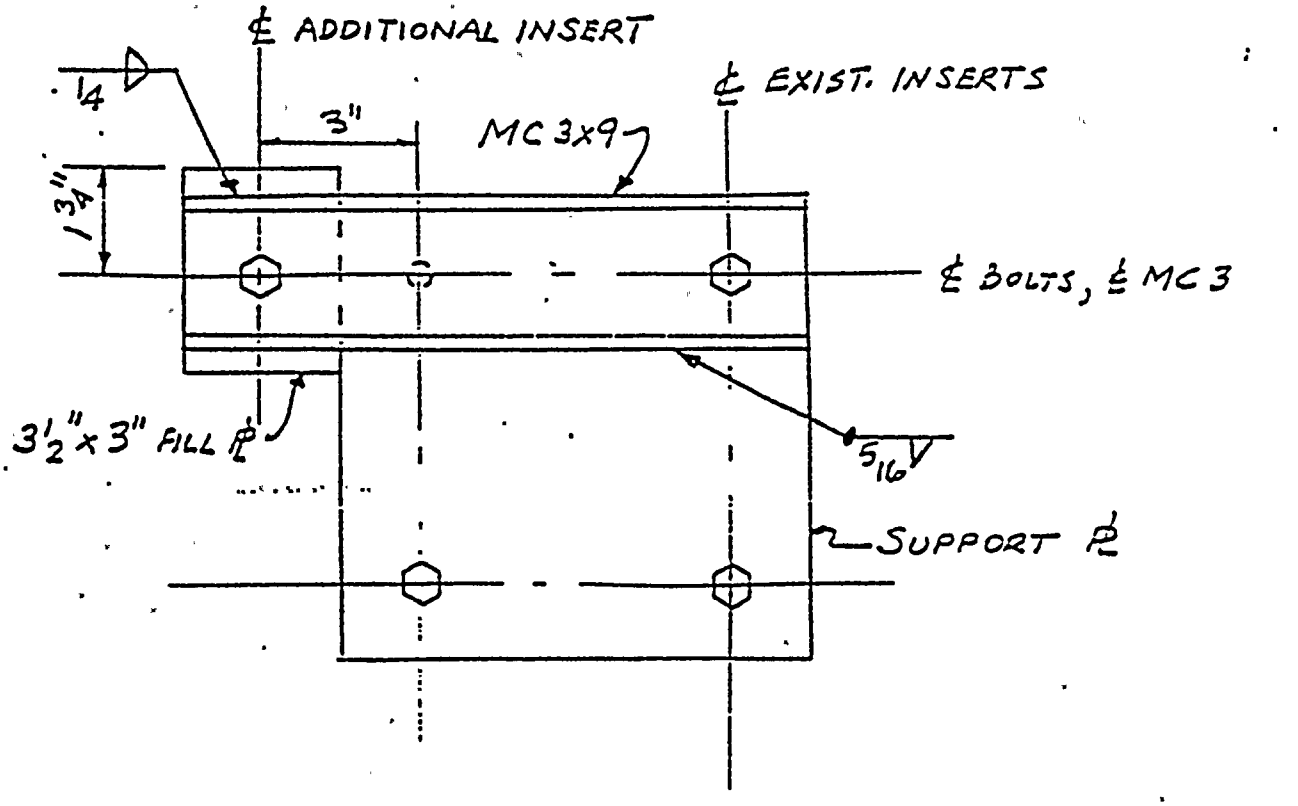
3. USE SAME SIZE ADDITIONAL INSERTS AS EXIST. INSERTS.

4. MAY BE USED FOR REPLACING ALL 4 BOLTS ON A 4 BOLT PL

W.O. No. 3808 Date 3/27/78 Book No. SXI - Page No.
Drawing No. NA Calc. No. 6.25.02 Sheet 3 of
By MHH. Checked UF 3/30/78 Approved [illegible] 3/31/78
Title WPPSS ~ HANFORD No. 2 ~ PIPE SUPPORTS

GENERIC FIX FOR SUPPORT ℄ W/IMPROPERLY INSTALLED DRILLED-IN INSERT.

FIX NO. 2



NOTES: 1. USE SAME SIZE ADDITIONAL INSERT AS EXIST. INSERT

2. CHECK THAT EXIST. INSERTS DO NOT BECOME OVERLOADED

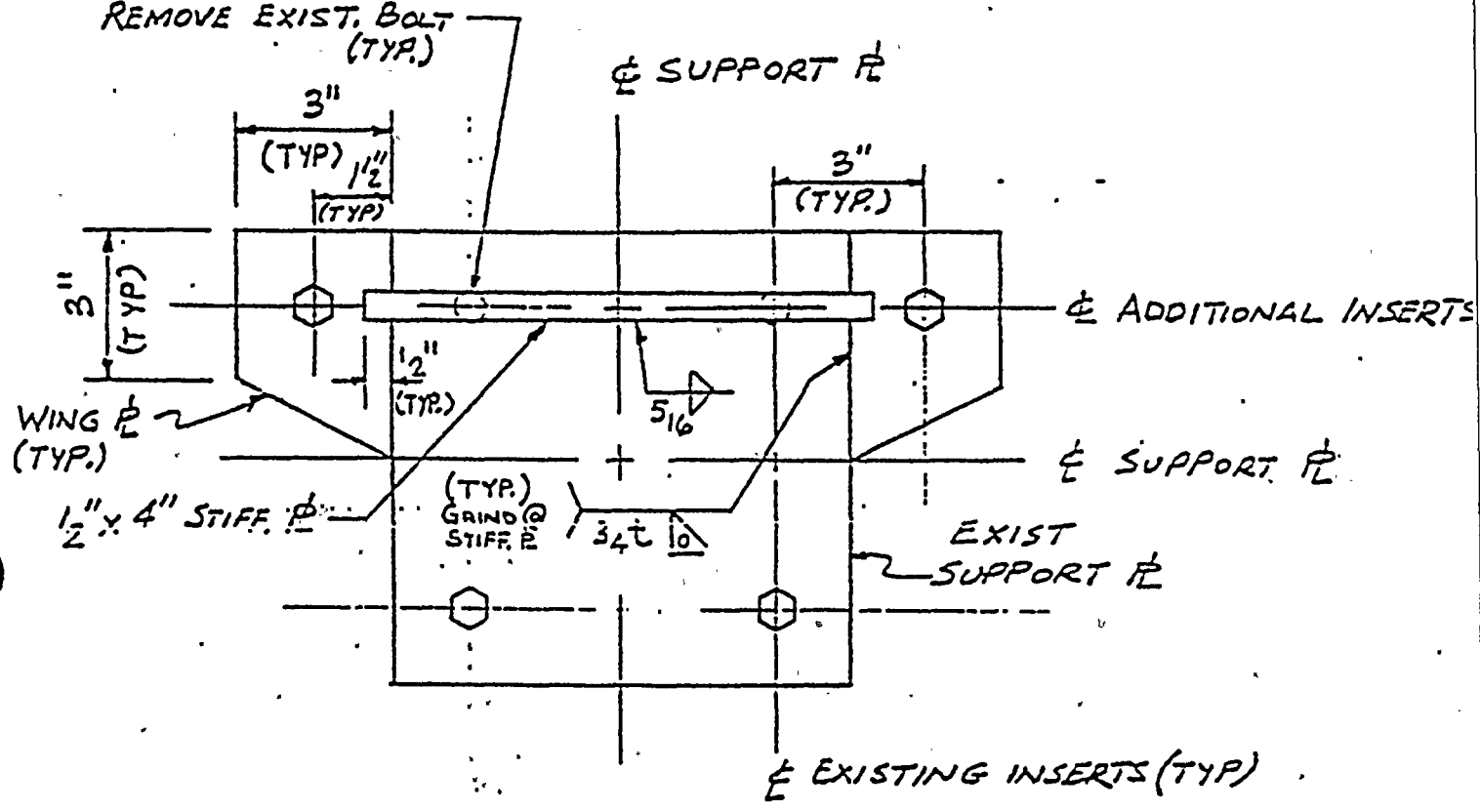
3. IF EXIST. INSERTS BECOME OVERLOADED USE FIX No. 1

BURNS AND ROE, INC.
New Jersey • New York • Connecticut • California

W.O. No. 3808 Date 3/28/78 Book No. SK1 Page No.
Drawing No. NA Calc. No. 6.25.02 Sheet 4 of
By TMOH. Checked LE 3/30/78 Approved [illegible] 3/78
Title WPPSS ~ HANFORD NO. 2 ~ PIPE SUPPORTS

GENERIC FIX FOR SUPPORT ℄ W/IMPROPERLY INSTALLED DRILLED-IN INSERTS

FIX NO. 3



NOTES: 1. t = SUPPORT ℄ THICKNESS = WING ℄ THICKNESS

2. USE AS SHOWN FOR REPLACEMENT OF 2 BOLTS ON ANY SIDE.

3. USE FOR FOUR BOLT ℄'S. DETAIL MAY BE USED ON BOTH SIDES OF ℄ TO REPLACE ALL FOUR BOLTS IF REQ'D

4. USE SAME SIZE ADDITIONAL INSERTS AS EX

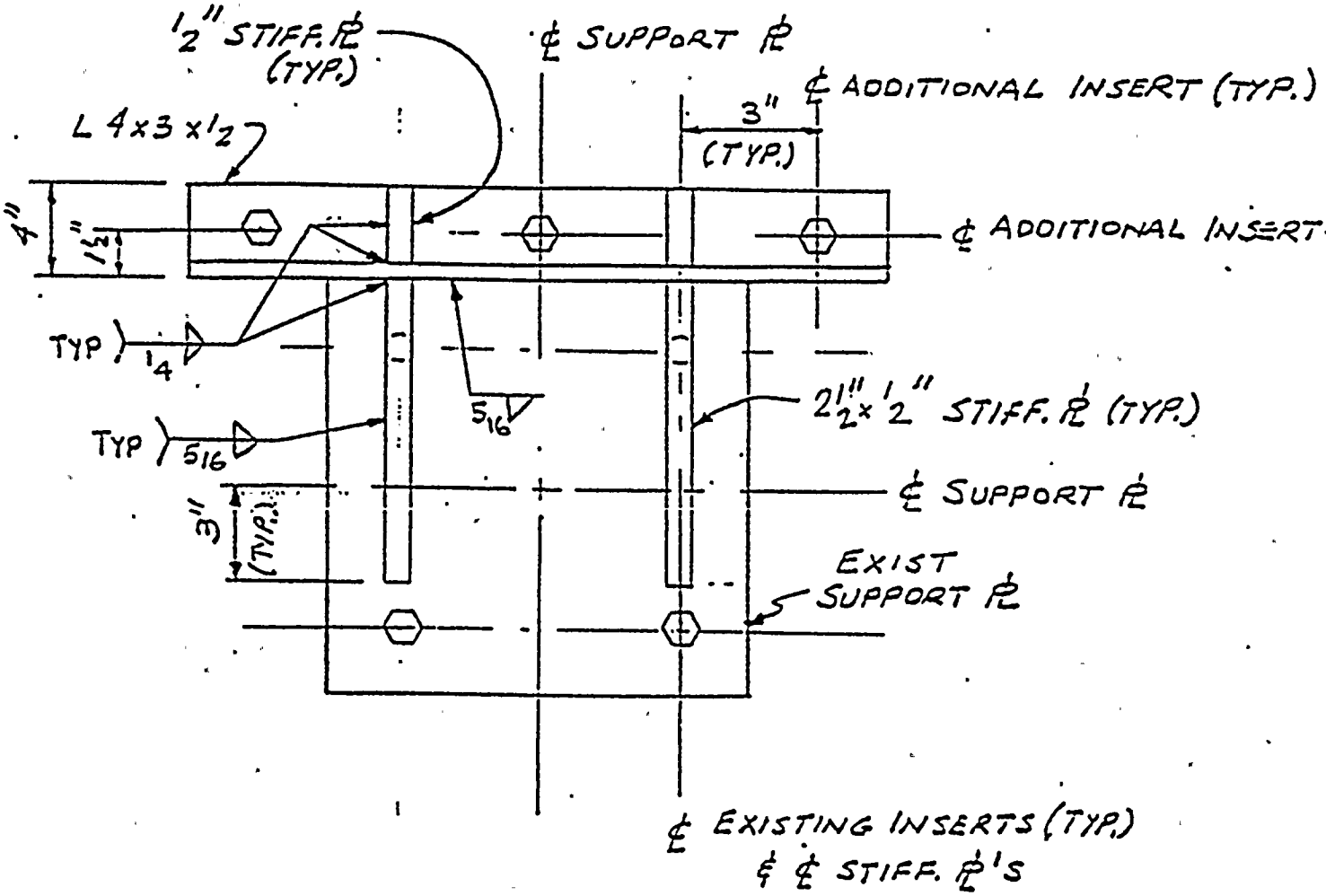
Exhibit E

BURNS AND ROE, INC.
New Jersey • New York • Connecticut • California

W.O. No. 3803 Date 3/27/78 Book No. SK Page No.
Drawing No. NA Calc. No. 6.25.02 Sheet 5 of
By MAH. Checked LE 3/30/78 Approved [illegible] 4/3/78
Title WPPSS – HANFORD NO. 2 – PIPE SUPPORTS

GENERIC FIX FOR SUPPORT ℄ W/IMPROPERLY INSTALLED DRILLED IN INSERT.

FIX NO. 4



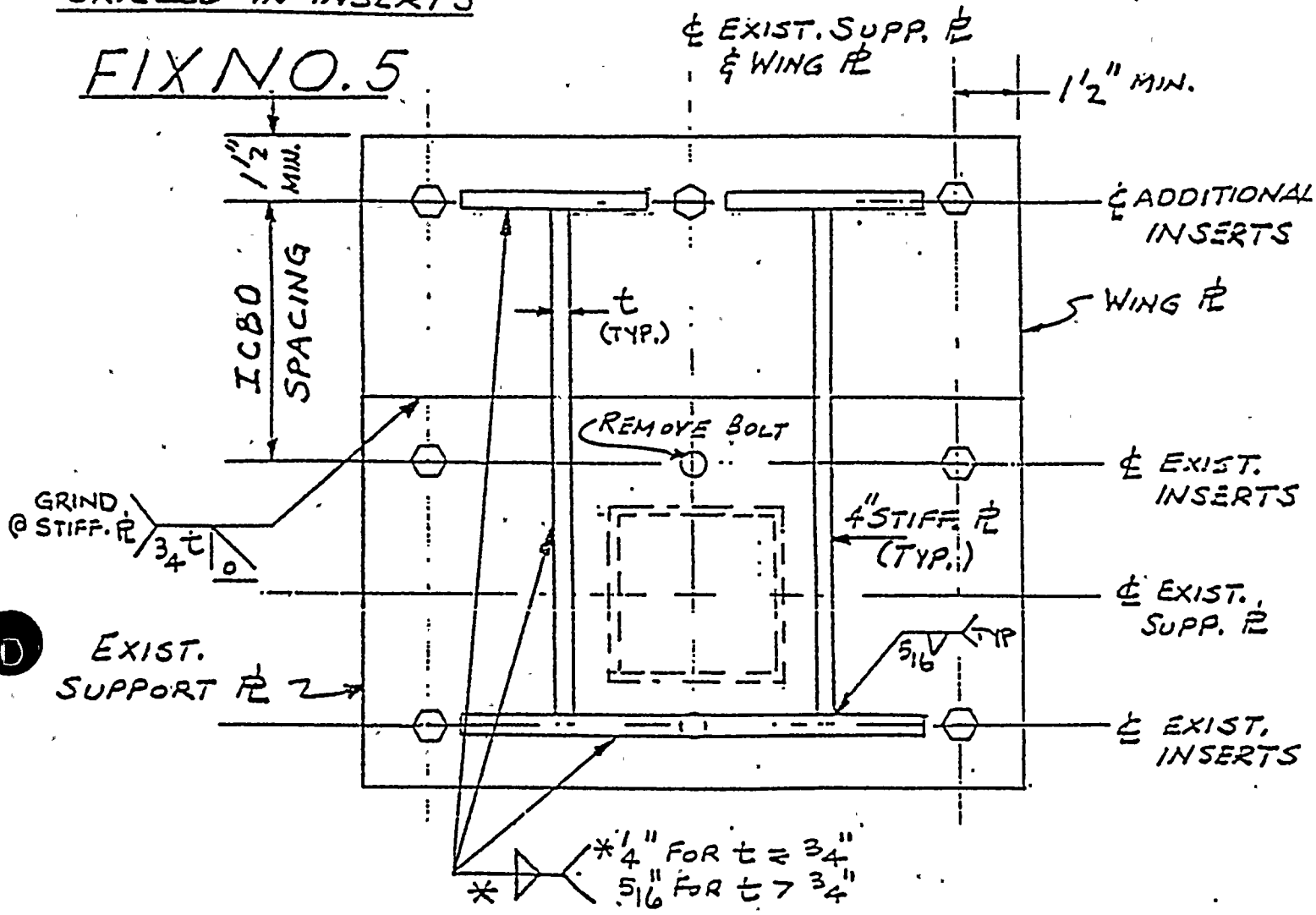
NOTES: 1. USE SAME SIZE ADDITIONAL INSERT AS EXISTING INSERT
2. CHECK THAT EXIST. INSERTS DO NOT BECOME OVERLOADED

W.O. No. 3808 Date 3/20/78 Book No. SXI- Page No.
Drawing No. NA Calc. No. G.75.02 Sheet 6 of
By MHH Checked LF 3/30/78 Approved 4/7/78
Title WPPSS ~ HANFORD No. 2 ~ PIPE SUPPORTS

D

GENERIC FIX FOR SUPPORT ℄ W/IMPROPERLY INSTALLED DRILLED-IN INSERTS

FIX NO. 5



D

D

C

NOTE: 1. t = THICKNESS OF EXISTING SUPPORT ℄ & WING ℄

2. FIX MAY BE USED FOR 2 CENTER BOLTS ON 6 OR 8 BOLT ℄.
3. CHECK THAT EXIST. INSERTS DO NOT BECOME OVERLOADED.

DRILLED-IN CONCRETE ANCHOR INSPECTION PROGRAM FLOW CHART

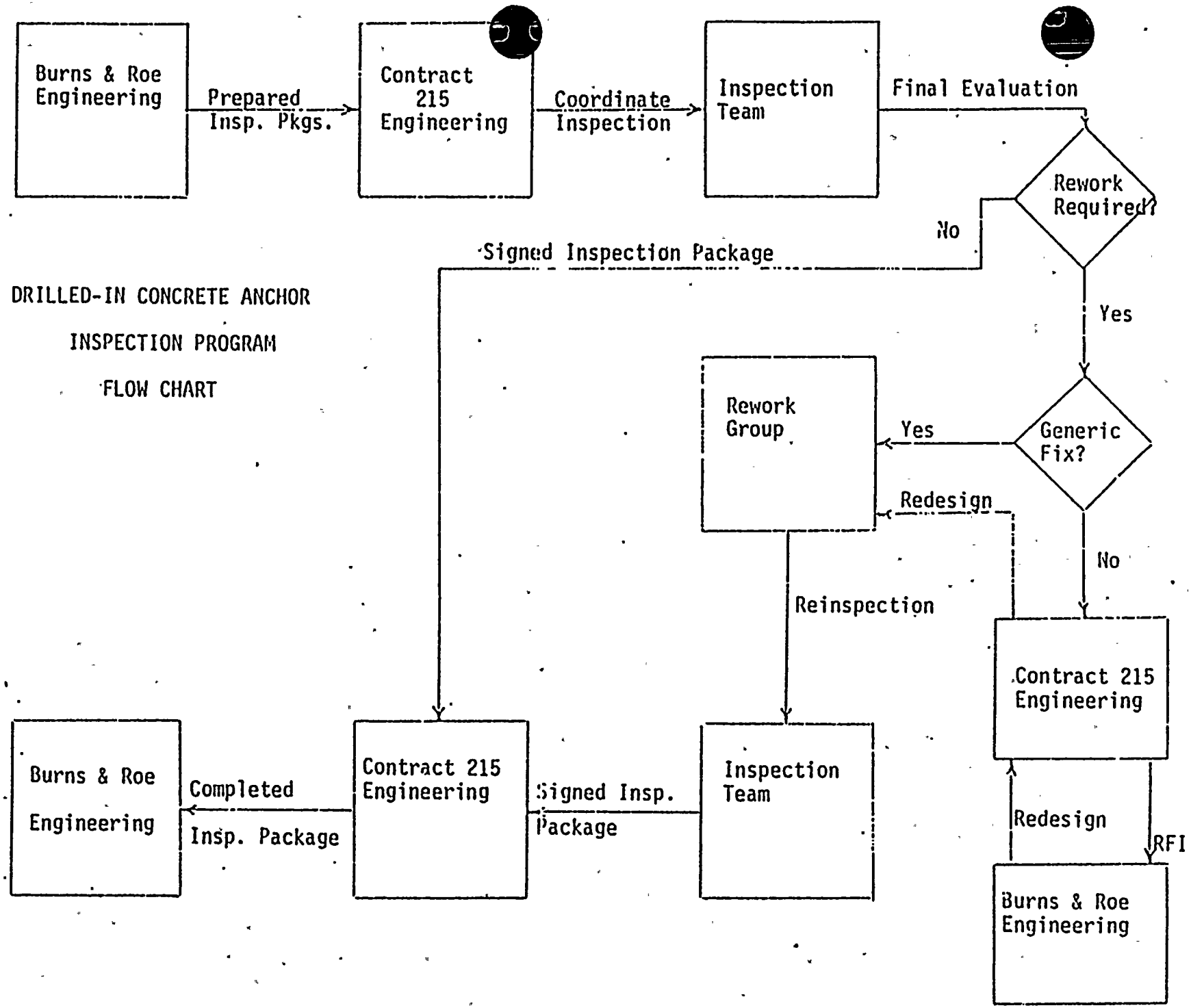


EXHIBIT F

NRC STATISTICAL SAMPLING METHOD AND C215 SAMPLE RETROINSPECTION PROGRAM

This exhibit is referenced in paragraph 4.4.2 of the response to the Bulletin.

NRC STATISTICAL SAMPLE METHOD

Table 1 - Initial Sample Size to Assure
at 95% Confidence Level 5% Defective

Population Size	Sample Size (with no failures)
40	31
60	38
80	42
100	45
200	51
300	54
400	55
500	56
600	56
700-1200	57
1300-3000	58
Greater than 3000	60

Table II - Defectives Allowed

Sample Size	Allowable No. of Defectives
100	2
200	6
300	9
500	18
700	26
1000	40
3000	131

Exhibit F

BURNS AND ROE, INC.
WPPSS
NUCLEAR PROJECT
NO. 2

PROJECT
ENGINEERING
DIRECTIVE

CODE	PROJECT ENGINEERING DIRECTIVE
2 1	2 1 5 – C S – 2 3 4 5
1 2	3 4 5 6 7 8 9 10 11 12 13 14 15
DATE	0 1 / 0 7 / 8 2
X	16 17 X 18 19 X 20 21

REASON FOR P. E. D.:

To provide the necessary direction to the Contractor to perform a sample inspection of drilled-in concrete anchors which were installed between February 1978 and July 1979.

INFORMATION COPIES NA

SHEET 1 OF 4

INFORMATION COPY

REFERENCES	
SUBJECT	Concrete Anchor Inspection
LOCATION	Various
ENG. SYSTEM	Various
S/U SYSTEM	970.0
QUALITY CLASS	I & Seismic Cat. I
ORIGINATING DOCUMENTS	BECOR-F-81-0850 RFI 215-7429

DESCRIPTION OF WORK:

PED 215-CS-2401 provided retro-inspection requirements for anchors installed prior to February 1978. PED 215-CS-1019 provided inspection requirements for new installations performed after July 1979. It is the intent of this PED to initiate a sample inspection program of the anchors installed between these dates.

Attached is a list of 69 hangers which are distributed through the plant. The Contractor shall select 60 hangers from the list for this sample inspection program. The selected hangers shall be Quality Class I, Seismic Category I and utilize drilled-in concrete anchors which were installed between February 1978 and July 1979. Also attached is a form entitled, "Supplement to Hanger Inspection Checklist NF-237".

The Q.C. Inspector shall first review the Hanger Inspection Checklist, form NF-237, in each selected hanger package. The inspector shall fill in the required information on the "Supplemental" form and check-off those items which were previously verified on form NF-237. The inspector shall then, if necessary, field inspect, in accordance with Contractors current approved procedures, one of the drilled-in concrete anchors on each of the baseplates of the selected hangers for those items on the attached "Supplemental" form which were not previously verified on form NF-237. Use a separate form for each anchor. All items which do not conform to the requirements of the procedure shall be indicated on this form by the inspector.

NOTES

1. THIS PED REVISES DIRECTION PREVIOUSLY PROVIDED BY NA THE FOLLOWING PED(s):
2. THIS PED VOIDS DIRECTION PREVIOUSLY PROVIDED BY PED 215-CS-2405 THE FOLLOWING PED(s): PED 215-CS-3269
3. THIS PED WORK SHOULD BE COORDINATED WITH KNOWN OTHER C 215 WORK UNDER THE FOLLOWING PED'S: PED 215-CS-1019 PED 215-CS-2401
4. THIS PED DEPENDS ON THE PRIOR INSTALLATION OF THE FOLLOWING PED'S: NA

REVISE:

NONE X
DRAWINGS --
SPECIFICATION --

APPROVALS:

DISCIPLINE ENGINEER	DATE 1-7-82
RES. GROUP SUPERVISOR	DATE 1/8/82
S/U LIAISON ENGINEER	DATE 1-8-82
RESIDENT PROJECT ENGINEER	DATE 1/15/82

REV 2 SR 803-2

NO MWL INPUT REQUIRED
DATE JAN 11 1982

Exhibit F

Prior to loosening the bolt/nut, of an anchor to be field inspected, measure and record the breakaway torque required to just initiate additional tightening of it. It is recommended this be performed with a torque wrench which has a dial indicator read-out. When this torque is less than specified in the procedure, tighten the bolt/nut to the specified value prior to performing this inspection.

All items on the Supplemental Checklist must be filled in. When the required information is not available, place a NA in space provided. When an item does not apply to the installation, cross that item out. The complete "Supplemental" form shall become a part of the hanger package. Contractor shall transmit a copy of the complete form, a copy of the anchor original NF-237 inspection form, and any other pertinent information found during this sample inspection program to L. Noble, Burns and Roe Engineering, for evaluation.

REF. DOC.: PCN ——— RFI 215-7429		WPPSS NUCLEAR PROJECT NO. 2
REF SPEC. SECTION: ——— PAGE ——— PARA: ———		BURNS AND ROE, INC.
REF. DWG. ———	DWG. ZONE: ———	PED 215-CS-2345 SHT. 2 OF 4
SCALE: ———	DRAWN BY C. Hyde DATE: 1/7/82	TITLE: Concrete Anchor Insp
	CHKD BY W. Sweeney DATE 1/7/82 APPVD: D. Swanson DATE 1/8/82	

REV 1

Exhibit F

LIST OF HANGERS

Hanger No.	Hanger No.	Hanger No.
AS-114	MS-333	RHR-399
AS-132	MS-334	RHR-412
AS-153	MS-335	RHR-910N
AS-166	MS-336	RHR-919N
AS-182	MS-337	RHR-949N
DE-6	RCC-324	RHR-973N
DE-15	RCIC-6	RRC-2
DE-24	RCIC-79	RRC-6
DE-44	RCIC-920N	RWCU-92
DE-58	RFW-63	RWCU-136
FPC-61	RFW-65	RWCU-137
FPC-64	RFW-66	RWCU-138
HPCS-43	RFW-67	RWCU-159
LPCS-28	RFW-69	RWCU-160
LPCS-901N	RFW-73	RWCU-164
LPCS-902N	RHR-6	RWCU-165
MS-28	RHR-11	RWCU-166
MS-29	RHR-37	RWCU-167
MS-31	RHR-179	RWCU-229
MS-33	RHR-209	RWCU-235
MS-36	RHR-245	RWCU-262
MS-275	RHR-328	RWCU-272
MS-319	RHR-371	VR-8

REF DOC PCN — RFI 215-7429 | WPPSS NUCLEAR PROJECT NO. 2

SPEC. SECTION — PAGE — PARA | BURNS AND ROE, INC.

REF DWG. — DWG. ZONE — PED 215-CS-2345 | SHT 3 OF 4

SCALE. — DRAWN BY L. Hyde DATE 1/7/92 — CHKD BY [illegible] DATE 1/7/92 — APPVD [illegible] DATE 1/8/92

TITLE. Concrete Anchor Inspection

Exhibit F

SUPPLEMENT TO WELDED INSPECTION CHECKLIST NF-237

(Reference PED 215-CS-23-3)

Hanger/Detail No. _____ Rev. _____ Quality Class _____ Seismic Class _____

Hanger originally inspected to Revision _____ of NF-237. Date anchors installed _____

- Anchors originally torqued with Wrench I.D. _____

- Measure the torque required to just start tightening bolt/nut: Torque _____
  (When less than proper torque, apply proper torque) Wrench I.D. _____

- Inspect only those items not previously verified on NF-237

INSPECTION ITEM	VERIFICATION ON *		Q.C. Sign-Off Date
	NF-237	this form	
1) Verify proper anchor type per hanger detail (Check one)** ____PRH ____HDI ____HKB			
2) Verify proper anchor size per hanger detail			
3a) Verify proper relative dimension (PRH only)			
3b) Verify setting tool shouldered on anchor (HDI only)			
3c) Verify embedment depth in concrete (HKB only)			
4) Verify anchor not pulled against plate(PRH & HDI only)			
5) Verify proper thread engagement			
6) Verify proper plate bolt hole size			
7) Verify proper free concrete edge spacing			
8) Verify proper anchor spacing from embedded items			
9) Verify anchor achieves proper torque after above inspection. Torque Wrench I.D. _____	X		

* Check the correct column

** PRH = Phillips Red-Head Anchor, HDI = Hilti Drop-In Anchor, HKB = Hilti Kwik Bolt Anchor

The drilled-in concrete anchor inspection required by this checklist shall be performed in accordance with Contractor's current procedure.

Procedure used _____ Revision _____

Comments: _____

_____

_____

Q.C. Inspector _____ Date _____

(Send a copy of this complete form and a copy of the form NF-237 in the hanger package to L. Noble, B & R Engineering. Attach original of this form to form NF-237 in hanger package)

SKETCH OF HANGER BASEPLATE: (Show location of anchor being inspected)

EXHIBIT G

C215 SAMPLE PARABOLT RETROINSPECTION PROGRAM (C233 INSTALLATIONS)

This exhibit is referenced in paragraph 4.4.6 of the response to the Bulletin.

BURNS AND ROE, INC.
WPPSS
NUCLEAR PROJECT
NO. 2

PROJECT ENGINEERING DIRECTIVE

CODE: 2:1 | PROJECT ENGINEERING DIRECTIVE: W.2.1.5 - I.C.S - 1.9.3.4

DATE: 11/26/79 | PRIORITY: I

INFORMATION CONTRACTORS: NA | SHEET 1 OF 10

REASON FOR P.E.D.:

To sample, inspect and test parabolt concrete inserts for integrity per NRC I.E. Bulletin 79-02.

REFERENCES

SUBJECT	Parabolt Inserts
LOCATION	Spray Ponds 1A & 1B
ENG. SYSTEM	A11
S/U SYSTEM	A11
QUALITY CLASS	I
ORIGINATING DOCUMENTS	NRC I.E. Bulletin 79-02

REFERENCE DRAWINGS

REVISE	DRAWING NO. – SHEET NO. – SUFFIX – REV.
N	S533 – – – -02
N	S534 – – – -03
N	S535 – – – -02
N	S536 – – – -02

REFERENCE SPEC. PARAGRAPHS

REVISE	PARAGRAPH	PAGE	REV.

DESCRIPTION OF WORK:

See attached sheets.

C 68161

NOTES

1. THIS PED REVISES DIRECTION PREVIOUSLY PROVIDED BY THE FOLLOWING PED(S): NA
2. THIS PED WORK SHOULD BE COORDINATED WITH KNOWN OTHER CONTRACTOR WORK UNDER THE FOLLOWING PED'S: NA
3. THIS PED DEPENDS ON THE PRIOR INSTALLATION OF THE FOLLOWING PED'S: NA

APPROVALS:

DISCIPLINE ENGINEER — DATE: 11-26-79

LEAD ENGINEER — DATE: 12.5.79

COG. CONTRACT ENGR. — DATE

S/U LIAISON ENGR.

Exhibit G

Description of Work

1.0 Contractor will inspect and test concrete inserts from the walls and slab of Spray Ponds 1A & 1B that were installed by Contract #233.

a) From the attached drawings S533-S536, sheets 7,8,9, & 10 of this PED, Contractor will select one bolt from each plate denoted by mark number. (i.e. Plate 13, Plate 14, etc.)

b) The selected bolt will be numbered (i.e. 1,2,3, or 4, etc.). Bolt number 1 will be considered from the north upper left corner of the plate. Numbers will increase consecutively moving clockwise around the plate.

c) Refer to item 2.0, this PED, for inspection and testing.

d) Submit results of inspection and testing to Engineer by letter on Exhibit "A" (Sheet 6).

2.0 Inspection and testing of the installed expansion bolts shall consist of the following:

2.1 Results to be entered on Exhibit "A" (Sheet 6)

2.2 The contractor will inspect the following items:

a. Proper size anchor
b. Proper type anchor
c. Embedment depth
d. Thread engagement
e. Plate bolt hole size
f. Bolt spacing
g. Edge distance
h. Torque

2.3 Torque Testing: A calibrated torque wrench shall be used for this test.

a. This test shall consist of applying torque in the tightening direction to the embedded anchor. Torque shall be applied until additional tightening of the nut is observed, or until the specified maximum torque value is reached, whichever occurs first. If tightening is observed before reaching the specified maximum, this breakaway torque value shall be recorded and checked to assure that it is greater than the specified minimum torque, as shown on sheet 4.

C 68-162

REF DOC PCN ——— RFI ———			WPPSS NUCLEAR PROJECT NO. 2
REF SPEC SECTION ——— PAGE ——— PARA ———			BURNS AND ROE, INC.
REF DWG ———		DWG ZONE ———	PEC 215-CS-1934 SHT 2 OF 10
SCALE	DRAWN BY K. Robe DATE 11-25-75	REVIEWED DATE	TITLE PARABOLT INSERTS Exhibit G
	CHKD BY J.O. Moffat DATE 11/26/75	APPVD MJS DATE 12.5.75	

Torque (Ft-lbs.)

Size	Minimum
1/2"	45
3/4"	125
7/8"	165
1"	250

2.3 (continued).

b. Any turning, lateral and/or vertical motion of the embedded anchor, looseness of the anchor system, or other forms of unsteadiness of the embedded anchor observed during the torque test shall be cause for rejection. The torque test shall be performed without any special lubricant on the threads.

2.4 Edge distance: taken from the centerline of the bolt to the edge of the concrete. (Refer to Table III on sheet 5).

2.5 Bolt spacing: refer to Table III for minimum.

2.6 Plate bolt hole size: maximum 1/8" larger than the anchor size.

2.7 Thread engagement: full thread engagement.

2.8 Embedment depth:

a) Refer to Table III for minimum.
b) The ultrasonic equipment used shall be a NORTEC 131 CRT or approved equal.
c) The U.T. equipment shall be calibrated to a standard length Parabolt specimen prior to inspection of each mark number and more often if required.
d) Each Parablot shall be U.T.'d for length. Prior to applying the transducer to the end of the bolt, ascertain that the bolt end is relatively smooth and perpendicular to the axis of the bolt. If needed touch up with a file. Subtract the exposed length from the total length to get the embedded length and record the actual embedment on Exhibit "A".

2.9 Proper type anchor: Molly Parabolt concrete anchors.

2.10 Proper size anchor: refer to reference drawings S533, S534, S535, S536.

C 68463

REF. DOC PCN ———	RFI ———		WPPSS NUCLEAR PROJECT NO. 2
REF SPEC. SECTION ———	PAGE. ———	PARA: ———	BURNS AND ROE, INC.
REF DWG ———		DWG. ZONE. ———	PEC 215-CS-1934 SHT 2 OF 10
SCALE.	DRAWN BY R. Robertson DATE 11-24-75	REVIEWED DATE	TITLE: PARABOLT Exhibit G INSERT
	CHKD BY [illegible] DATE 11/26/75	APPVD [illegible] DATE 12-5-75	

2.11 If any inspected item fails to meet its acceptance criteria, the anchor will be considered to have failed inspection.

2.12 If any anchor on a plate fails, all other anchors on the plate shall be inspected.

3.0 Rejected Expansion Bolts:

Rejected bolts will be noted as such on Exhibit "A" and submitted to the Engineer (B & R).

4.0 References:

Installation Procedure - Field Procedure FP-EB-1 Rev. 3, Paragraphs 2.4 and 2.5 (B & R File 233-00-0046)

C 68464

REF DOC PCN —— RFI ——			WPPSS NUCLEAR PROJECT NO. 2
REF SPEC. SECTION —— PAGE —— PARA: ——			BURNS AND ROE, INC.
REF DWG ——		DWG ZONE ——	PED 215-CS-1934 SHT 21 OF 1A
SCALE	DRAWN BY L. A. Rohn DATE 11-26-79	REVIEWED DATE	TITLE PARABOLT Exhibit G

TABLE III

SIZE	THREAD LENGTH	HOLE DIAMETER	MINIMUM EMBEDMENT	MINIMUM * SPACE BETWEEN BOLTS	MINIMUM EDGE DISTANCE
1/4"	3/4"	1/4"	1 1/8"	3"	1 1/2"
3/8"	1 1/8"	3/8"	1 1/2"	4 1/2"	2 1/4"
1/2"	1 1/4"	1/2"	2 1/4"	6"	3"
5/8"	1 1/2"	5/8"	2 3/4"	7 1/2"	3 1/4"
3/4"	1 1/2"	3/4"	3 1/4"	9"	4 1/2"
7/8"	2 1/4"	7/8"	4"	10 1/2"	5 1/4"
1"	2 1/4"	1"	4 1/2"	12"	6"

* Minimum space between bolts shall be as specified above or as noted on B & R contract drawings (S533, S534, S535, S536).

C 68465

REF DOC PCN ——	RFI ——		WPPSS NUCLEAR PROJECT NO. 2
REF SPEC. SECTION ——	PAGE ——	PARA: ——	BURNS AND ROE, INC.
REF DWG ——		DWG. ZONE: ——	PED 2V5-CS-1934 SHT 5 OF 10
SCALE	DRAWN BY [illegible] DATE 11-20-79	REVIEWED	DATE
	CHKD BY [illegible] DATE 11/21/79	APPVD [illegible]	DATE 12.5.79

TITLE: PARABOLT INSERT

Exhibit G

SAMPLE TESTING OF EXPANSION BOLTS PER
NRC BULLETIN 79-02
EXHIBIT "A"

MARK NO. BOLT NO.	BOLT SIZE (DIA. INCH.)	EMBEDMENT DEPTH (INCHES)	THREAD ENGAGEMENT (YES/NO)	PLATE HOLE SIZE (INCHES)	BOLT SPACING (INCHES)	EDGE DISTANCE (INCHES)	TORQUE (FT-LB.)	ACCEPT/ REJECT	INSPECTOR INITIAL & DATE	Comments